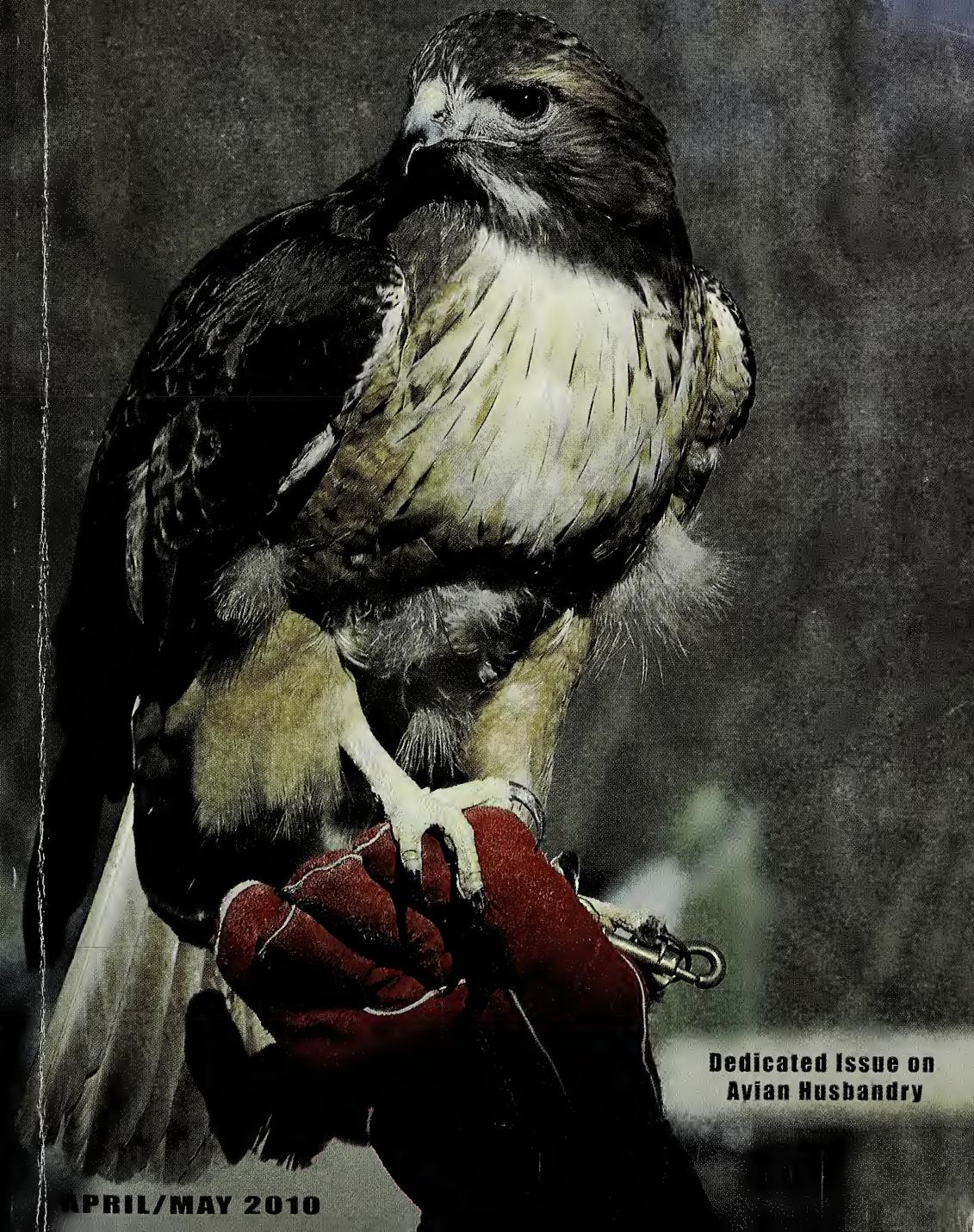


# ANIMAL KEEPERS' FORUM

The Journal of the American Association of Zoo Keepers, Inc.



Dedicated Issue on  
Avian Husbandry

APRIL/MAY 2010

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# *Table of Contents*

2010 AAZK Conference Notice/Information for Contributors.....	131
About the Cover.....	132
From the President/From the <i>AKF</i> Editor.....	133
Learning to Walk Again: Paralysis in an African Penguin.....	134 - 138
Development of an Aviary Training Program: Enhancing the Daily Management of Zoo Atlanta's Bird Collection.....	140 - 144
Hand-Rearing Caribbean & Chilean Flamingo Chicks at the Birmingham Zoo.....	145 - 148
Breeding Cinereous Vultures at the Milwaukee County Zoo.....	149 - 153
The Use of Vocal Playback as a Tool for Breeding in Captive Birds - Collaborators Sought.....	153
Avian Rearing Resource Website.....	154
Designing a Keeper and Bird-Friendly Enrichment Program.....	155 - 157
Successfully Raising Parent-reared Chicks from Elegant-crested Tinamou.....	158 - 160
Ratite Behavioral Husbandry at the Philadelphia Zoo.....	161 - 163
Frogmouth Management at Sea World Orlando and Discovery Cove.....	164 - 168
Incubation and Hand-rearing of a Greater Rhea at the Great Plains Zoo.....	169 - 172
First Time Breeding of Captive Sulawesi Knobbed Hornbills at St. Augustine Alligator Farm Zoological Park.....	173 - 175
Artificially Inseminating White-naped Cranes.....	176 - 182
Enrichment and Training...It's For the Birds.....	183 - 189
Jess Free.....	190 - 192
Greater Flamingo with Capture Myopathy: Specialized Care and Husbandry.....	193 - 195
Successful Rearing of an African Sacred Ibis Chick at the Toronto Zoo.....	196 - 200
Feather Facts.....	200
Semen Collection on Rockhopper and Gentoo Penguins at the Indianapolis Zoo.....	201 - 205

Setting Up a Picture Perfect Success.....	206 - 208
Supplemental Feedings to Aid a Parent-reared African Pygmy Falcon Chick.....	209 - 212
Breeding White-crested Laughing Thrush at the Birmingham Zoo.....	213 - 219
Types of Feathers.....	219
The Management and Breeding Program for Roseate Spoonbills at the Palm Beach Zoo at Dreher Park.....	220 - 224
Feather Types - Did You Know?.....	224
Puppets: Construction and Use for the Hand-rearing of Birds.....	225 - 230
Raising Red-Vented Bulbuls in Tropic World Asia Bird Holding.....	231 - 233
Sessions for All Seasons: Lappet-faced Vulture Training.....	234 - 237
Avian Trivia.....	237
Successfully Managing a Mixed-Species Free-Flight Aviary.....	238 - 246
Book Review ( <i>On the Wings of Cranes</i> ). ....	247
Avian Websites to Check Out.....	247
African Penguin (Photo). ....	248



*36th Anniversary - 1974 - 2010*

**MISSION STATEMENT**

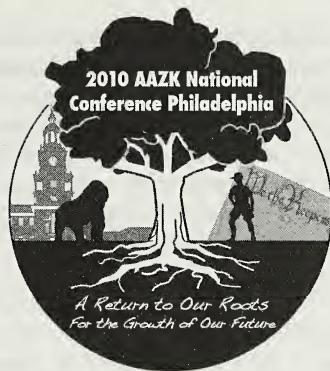
*(Revised April 2009)*

American Association of Zoo Keepers, Inc.

*The mission of the American Association of Zoo Keepers, Inc. is to advance excellence in the animal keeping profession, foster effective communication beneficial to animal care, support deserving conservation projects, and promote the preservation of our natural resources and animal life.*

## **ATTENTION !!!**

Registration is now open for the 2010 National AAZK Conference in Philadelphia! This year's conference is August 22-26, 2010. To ensure that you get the early registration price, you must register by June 22, 2010!! To register, please visit our website, [www.philadelphiaaaazk.org](http://www.philadelphiaaaazk.org) and click on "2010 National Conference." Delegates may purchase either a full-week or a single-day registration. Full-week registration for AAZK, ABMA and ICZ members is \$195 and for non-members is \$250. After June 22, 2010, there will be an additional \$50 late registration fee.



Articles sent to *Animal Keepers' Forum* will be reviewed by the editorial staff for publication. Articles of a research or technical nature will be submitted to one or more of the zoo professionals who serve as referees for *AKE*. No commitment is made to the author, but an effort will be made to publish articles as soon as possible. Lengthy articles may be separated into monthly installments at the discretion of the editor. The editor reserves the right to edit material without consultation unless approval is requested in writing by the author. Materials submitted will not be returned unless accompanied by a stamped, self-addressed, appropriately-sized envelope. Telephone, fax or email contributions of late-breaking news or last-minute insertions are accepted as space allows. Phone 785-273-9149; FAX (785) 273-1980; email is [akfeditor@zk.kscoxmail.com](mailto:akfeditor@zk.kscoxmail.com)<. If you have questions about submission guidelines, please contact the Editor.

**Deadline for each regular issue is the 10th of the preceding month.  
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## About the Cover.....

This month's cover features a Red-tailed Hawk (*Buteo jamaicensis*) photographed by Karl Rebenstorf, an animal care volunteer for the Virginia Living Museum in Newport News, VA. This particular bird is cared for and utilized by the staff and volunteers to educate students and public visitors. It came from the Wildlife Waystation of Sylmar, CA in 1993 and although the cause of injury is not known, this hawk is blind in one eye and unable to hunt, and therefore not a candidate for release. When a rehabilitation organization receives an injured Red-tailed Hawk, there are three most likely causes. The first is vehicular collision, likely due to the bird chasing its prey into traffic. The other two are shooting and accidental trapping.

Sometimes referred to in the United States as a "chickenhawk," it is one of the most common buteos throughout the North American Continent. Red-tailed Hawks can be found in just about every type of open habitat including deserts, grasslands, forests, pastures, parks, and urban areas. They feed primarily on small mammals such as mice, voles, rats, rabbits, snowshoe hares, and ground squirrels, but as an opportunistic feeder, their diet may also include birds, snakes, lizards, and carrion.

A male Red-tailed Hawk can weigh from approximately 1.56-2.875 lbs. [~708-1304g] and measure 18-22 in. long [~ 46-55cm]. Females, displaying sexual dimorphism in size, can weigh from approximately 2-3.25 lbs. [~ 907-1475g] and measure 19-26 in. long [~ 48-66cm], up to 25% larger than the males. Both have a wingspan of between 45-52 in. [~ 1.143-1.32m] and a broad tail that acquires its characteristic red color at about one year of age, after their first molt. They are the second largest buteo hawk in North America after the Ferruginous Hawk (*Buteo regalis*).

A mated pair will remain together in the same nesting territory for years and only take a new mate if one of the original pair dies. When courting, they perform an impressive aerial display in which they soar in wide circles at first. Then the male repeats a pattern of several steep dives and climbs before approaching the female when they briefly touch, sometimes grabbing onto each other and falling in spirals toward the ground before they separate.

Red-tailed Hawks typically will not begin to breed until three years of age. A pair will construct a new nest or refurbish an old one. The nests are comprised of piles of sticks as large as six feet high and three feet across [1.83m - 0.91m] and lined with softer vegetation. Nest placement will normally be near the top of a large tree on the edge of a forest canopy. A clutch size of two to four eggs are commonly laid between the months of April and May and will hatch out approximately 30 days later. The young, referred to as eyasses ("EYE-ess-ess") begin to leave the nest just after seven weeks of age. The fledglings will then follow their parents as they learn to fly and hunt for themselves until they can eventually survive on their own.

For use as program birds, the Raptor Center College of Veterinary Medicine at the University of Minnesota lists the Red-tailed Hawk among a small group of birds of prey referred to as the "Steady Six". The species in this group have proven to be the easiest to work with for educators. The other members of the steady six are the American Kestrel (*Falco sparverius*), Great Horned Owl (*Bubo virginianus*), Northern Saw-whet Owl (*Aegolius acadicus*), Eastern Screech Owl (*Megascops asio*), and Western Screech Owl (*Otus kennicottii*). To keep a Red-tailed Hawk you must have a Special Purpose Possession Education Permit, as required under the Migratory Bird Treaty Act, as well as any special permits deemed necessary by the state of residence. Thanks, Karl!

### References:

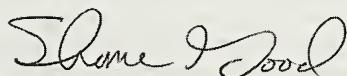
- Species page from The Raptor Center at the University of Minnesota
- Species page from The Cornell Lab of Ornithology
- The Wikipedia page on the Red-tailed Hawk
- A book called Raptors in Captivity by Lori R. Arent

## From the President . . .

I have always been impressed by the expert avian keepers within our membership, the ones who really know their birds from crown to tarsus. I'm talking about the keepers of indoor aviaries who can identify a hundred individual birds and tell you at any given time where they are hiding in the treetops. The flamingo keeper who can look out into the shallows amid a pink flurry of heads, wings, and legs and confidently proclaim she counted 72 birds. Are you kidding me? The raptor trainer who gives a bird of prey the freedom of flight and can actually get the thing to fly back for a measly scrap of meat. The weekend enthusiast who knows bird songs better than a Rosetta Stone graduate knows a foreign language. The expert ornithologist who unravels the mysteries of behaviors, vocalizations, and nesting and oversees her feathered charges from attraction to courtship, nesting to eggs, incubation to hatching, rearing to fledging.

This dedicated issue is for all of you, and for all of us who wish we knew our ornithology half as well as you do. The collection of papers is impressive, and a special thanks goes out to all of the authors, special editor Diane Olsen, and the Avian Scientific Advisory Group for helping to gather this important assembly of information.

My hope is that we continue to hear more from the bird keepers in AAZK and this is just the start of many more ornithological submissions. I also hope the aquarists, herpetologists, and other specialists take note and consider submitting a paper on their area of expertise. One of the most important components of AAZK's mission is the sharing of information. It is how we inspire innovation, achieve best practice, standardize knowledge, and recognize professional achievement. Congratulations to AKF Editor Susan Chan and the authors for achieving just that and creating a fine dedicated issue of the *Animal Keepers' Forum*.



Shane Good, President

## From the AKF Editor . . .

It is always exciting to work on a special issue of *AKF* dedicated to a particular group of animals. One of the real "perks" of my job is that I learn something new every day and continue to expand my animal knowledge base as members share with me their experiences and expertise. As an editor I always feel humbled when professionals entrust their manuscripts to me believing that I will do my utmost to make their articles turn out the best they can be.

I want to first thank Diane Olsen of Moody Gardens who served as special topic editor for this dedicated issue of *AKF*. Her support and advice along the way have been amazing. I would also like to thank each author who took the time and effort to submit material for this issue. I believe we have been able to cover a broad spectrum of topics within the Avian Husbandry theme and I truly hope that the information herein will be helpful to all bird keepers. I also hope the information and experiences detailed in this issue will make all non-avian keepers more aware of the challenges and rewards their colleagues who do work with the vast array of bird species deal with on a day-to-day basis.

One of the most difficult aspects of putting together this issue was to narrow down the potential cover subject photos from the many that were submitted. I want to thank all those who took the time and effort to submit their beautiful color photos of birds both in captivity and in the wild. I wish we had had room to utilize more of these great shots. Your willingness to share your photographic talents is much appreciated.



I hope you enjoy this Avian Husbandry issue of *AKF*.

Susan D. Chan, Editor

# Learning to Walk Again: Paralysis in an African Penguin

By Bethany Wlaz, Animal Keeper

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## Background

The Maryland Zoo in Baltimore houses the largest captive colony of African Penguins (*Spheniscus Demersus*) in North America. The long-standing colony at Rock Island has seen its share of trials and tribulations in order to reach its success. In September of 2008, the keepers, management and vet staff were faced with a unique medical situation that challenged the typical methods and ideals of penguin husbandry. The Maryland Zoo staff used intense physical therapy to treat a 17-year-old paralyzed African penguin. A dedicated staff willing to try some unconventional treatments in avian husbandry proved anything is possible, even when dealing with paralysis.

It was shortly after the morning feed that penguin number 825, "Leroy," was found lying outside his nest box unable to walk or stand. Keepers approached him and discovered he was not using his left leg. Leroy attempted to move, dragging his foot behind him. Less than 30 minutes prior, he was outside swimming in the moat and seen walking into the nest room. Immediately, keepers assumed it was a broken bone. After a trip to the zoo hospital for x-rays and a complete examination, they realized that it was not that simple. Unsure what could have happened, Leroy was initially treated with a non-steroidal anti-inflammatory and subcutaneous fluids and placed in Rock Island's hospital room. The hospital room is an isolated room with a pool within Rock Island that allows for isolation from the colony, but is next to the nesting room so that the birds can still hear each other and maintain some interaction when separated. In the hospital room, he was given a Plexiglass® box lined with towels, which was typically used for chicks (approximately 2x3 feet – 0.6m x 0.91m). The box would provide a safe place for Leroy away from the other birds that could harm him, and prevent him from attempting to move thus further injuring himself.

As mysteriously as his paralysis in his left leg appeared, the following day keepers arrived to find his right leg mysteriously lay limp as well. Zoo staff began brainstorming and investigating what could have caused this debilitation so suddenly without any obvious signs. Keepers struggled to find an environmental factor; did he fall getting out of the moat? Did he get in a fight with another bird? Why didn't anyone hear or see the fight? Vet staff ran blood tests, examined radiographs and researched further diagnostic possibilities. The paralysis only involved his legs, and he did not show any other symptoms. He had good cloacal and tail function. Further x-rays of his entire spine and vertebra revealed some very mild changes in his lower neck vertebra, but nothing conclusive. An MRI was arranged at a local human hospital on his entire spine and brain. Possible lesions were seen in the same area of neck vertebra as on the radiographs, but no obvious changes were revealed to suggest a definitive cause, or to further help in directing treatment.

## Treatment/Physical Therapy

After a few days, the seriousness and complexity that lay ahead became more apparent. Leroy was paralyzed and the chance of it being reversed was uncertain. Keepers prepared to make his living conditions more comfortable and medically appropriate. His chick box was layered with several pieces of two-inch foam and towels. The towels were tightly rolled and lined the entire box in order to encourage an upright posture. It was imperative that Leroy stay propped up for many reasons. Propping him up would help prevent sores from developing on his cloacal area and keel due to increased pressure in those areas. It also helped encourage a typical penguin posture thus not restricting any breathing since he would be in this position for extended periods of time. Perhaps most importantly, Leroy needed the towels and padding to help direct proper limb alignment.

After consultations with a human radiologist and a veterinary neurologist, vet staff quickly reacted and devised a treatment plan to the best of their ability. Leroy was initially treated with antibiotics and an antifungal medication. Corticosteroids were added after the MRI and much discussion since they would increase the risk of aspergillosis due to potential immune-suppression. However, the veterinary staff felt that steroids were necessary, which would reduce possible inflammation of the spinal cord and therefore decrease compression and the paralysis. Prednisone, an oral steroid,



Keepers performing physical therapy on Leroy

decrease muscle contraction from his paralysis and increase muscle strength in his lower limbs. Vet staff hoped if he regained any movement in his legs these exercises would help make it easier for him to begin walking again. The ROM exercises were performed for 15 minutes on each leg, three times a day. The physical therapy required two keepers, one to hold Leroy and the other to perform the motions. The motions flexed and extended the tibiotarsometatarsal (hock) joint and the stifle (knee) joint. Engaging the hip joint by creating a bicycle circular rotation was an important component of the stifle joint exercises.

For the next month, Leroy continued to be in good spirits and adjusted to the new living conditions and arrangements. He lived in the hospital room in his cushioned box and was taken out for three to four hours a day in order to receive his physical therapy and swim sessions. Within the first week of treatments keepers began to notice very small changes in Leroy's status. It was soon confirmed by vet staff that he had regained the first signs of limited mobility in his feet. Occasionally Leroy would extend his leg in efforts to get out of the pool, or would attempt to stand after pulling himself out of the pool. His strong desire to simply walk was seen through many attempts of pulling himself out of the pool and attempting to take himself back to his box. These actions on a daily basis forced him to push his body beyond its current physical limit. These little daily occurrences eventually became more frequent. It was difficult for keepers to detect progress when they were observing him on a daily basis. It was even more difficult to differentiate an actual voluntary leg movement from him straining other muscles and making it look like his leg was moving. After the first month it was clear to us that Leroy was no longer dealing with complete paralysis, but partial paralysis, coupled with his atrophied muscles. Leroy continued to move his legs slightly in the water and push himself to an upright position using his wings. Eventually he was able to hold himself in a standing position for a couple seconds.

Although keepers felt they could see progress, vet staff was still concerned about his long-term prognosis. Often the keepers were blinded by the joys of Leroy's progression. Seeing him attempt to pull his leg under his body, seemed like the milestone of all milestones, but in retrospect Leroy was still unable to walk. Staff had no diagnosis or indication if the treatments were actually working. A meeting was set to discuss his progress, chances of full recovery and quality of life. Just when the reality of the big picture and slim chance of full recovery began to cloud the optimism, Leroy used

was added at a moderately low dose with careful monitoring and weekly blood work.

The vets also felt strongly about the importance of keeping him in the water and giving him swim sessions in the hospital room pool. Keepers filled the pool half way and put Leroy in the water. He swam as a penguin should and at first glance may not have even appeared to have any problem. But it was evident that his inability to walk translated to the water as he used his wings alone to steer. The first couple of times were shaky. It was an adjustment for him to learn a new sense of balance. Keepers were directed to keep to a strict schedule of swim sessions three times a day. Perhaps most importantly, in addition to the medications, and daily swim sessions, a physical therapy program was devised. Keepers were to perform passive range of motion (ROM) exercises in order to



The hospital room was covered with mats and towels for more comfort. Keepers also made Leroy a ramp with Nomad® mat to help him exit the pool.



Mr. and Mrs. Leroy resting on the cushions.

resistance, and supported active ROM exercise twice a day. The toning massage was done by tapping fairly deeply and firmly on the leg muscles in several different points of the leg. The goal of this exercise was to make the muscles tense up after being stretched rapidly by finger pressure. The reflex stimulation with resistance required keepers to elicit a reflex while holding his leg extended so that he could not respond by pulling his leg away in order to force the muscles to work against the reflex. The final exercise, supported active ROM, was performed by holding him around the neck and supporting his body as he attempted to walk. Over time, the duration and walking distance were slowly increased.

Weeks went by and the time-consuming care of Leroy became routine. Physical therapy became more difficult to perform as he gained muscle strength and with each motion, there was more resistance from him. Leroy had gained enough movement and muscle tone in his legs and rump to stand. He had also figured out how to get out of the pool using both his legs with the help of his wings. Leroy was moved out of his cushioned box and given full access to the hospital room and pool at all times. The hospital room was lined with Nomad® Mats and towels to cover all concrete. Leroy's increased time in a larger area gave him many more opportunities to move on his own. He used his wings less and less and his feet more and more. After two months of paralysis, treatments, medication, and physical therapy, Leroy had learned to walk again. By no means was it a normal penguin walk, but a modified limp with hunched posture. It was still leaps and bounds from where Leroy was two months prior. Vet staff gave the ok to begin decreasing meds and discuss the possibilities of reintroduction to the colony.

### Problems Encountered

It should be noted that in addition to the direct stress and hardships faced dealing with Leroy's paralysis alone, many other secondary problems occurred. During the entire treatment process, Leroy suffered from many scrapes and lacerations on his wings. This was due to him supplementing his walking and mobility efforts with his wings. He was treated with New Skin® several times to stop and prevent bleeding. Keepers also encountered many time management issues. The Rock Island team was in the height of their breeding season, with 12 chicks to care for, one of which was being hand-reared. Approximately half of each eight-hour workday was dedicated to Leroy's care. With the Rock Island staff consisting of two keepers per day who were caring for approximately 50 penguins plus the chicks, and round-the-clock care of Leroy, staff was stretched thin. Physical

his legs to get out of the pool and stand on his own for the first time. Although the issue of quality of life kept surfacing, Leroy was constantly one step ahead, almost as if he was trying to convince staff to not give up on him.

After the first month, keepers, management and vet staff began to regain optimism. The physical therapy, steroids and swim sessions seemed to be working well. Vet staff decided to enhance the physical therapy plan by changing and increasing the exercises. A vet who specializes in animal physical therapy was contacted to devise a more targeted and intensive program with the goal to increase muscle mass and function. In addition to the previous exercises, keepers were to perform the following: a toning massage, reflex stimulation with



Photo shows Leroy using the corner and his wings to aid in getting out of the pool and attempting to stand.

therapy was time-consuming and keepers were unable to leave him unsupervised in the pool for swim sessions. Leroy needed to be supervised as he swam, to prevent him from banging his chest against the wall in attempts to get out, as well as cutting his wings on the steps. Vets feared that hitting his chest could cause more trauma to his spine or the skin covering his keel. Leroy received minor lesions on his feet from constant scraping in efforts to move, which in turn often became covered in fecal matter.

Keepers simultaneously dealt with a husbandry management issue. At the time of Leroy's paralysis he was recommended to breed by the Species Survival Plan® and had a long time mate of 16 years. This extremely bonded pair was faced with a series of problems when Leroy was moved in the hospital room. Although Leroy was kept in a small chick box with room only for himself, keepers immediately assumed that his mate should be with him. Penguin 826, "Mrs. Leroy" was moved into the hospital room to give him companionship and comfort through his hard time. Unfortunately this did not go as planned. Mrs. Leroy was clearly stressed out in the hospital room being away from her familiar nest box and colony access. Her eating suffered and there was an obvious onset of stereotypic pacing. Within a few days, it became clear to staff that it was best for Mrs. Leroy's health to keep her in the colony. Keepers feared that being away from his mate for so long could be detrimental to

Leroy's mental state. In addition, Mrs. Leroy began to be courted by another penguin in the colony during Leroy's absence. This posed many problems and forced staff to make decisions. If Mrs. Leroy stayed in the colony there was the risk of breaking the 16-year bond with her SSP® recommended mate. There was the added fear that if Leroy were able to someday be reintroduced to the colony, his once long-time companion and her new mate might turn on him and further injure Leroy as he tried to reunite with her. After the first month, it was decided that it was best to put Mr. and Mrs. Leroy together after all. Keepers then prepared the hospital room by completely lining the room with mats, towels and cushions to help pad for Mrs. Leroy's anticipated pacing. As expected, it took many weeks for her to become comfortable with being in the hospital room and regain her normal eating habits. Mrs. Leroy was also treated with an antifungal and an antibiotic as a preventative measure, as well as New Skin® for minor



Leroy was forced to sit backwards on his rump and hocks until he regained muscle.

scrapes on her feet. Towels and cushions were changed and cleaned daily to pad the room for the pair.

### Resolution and Current Condition

Approximately three months had passed and although Leroy did not have a normal or ideal penguin gait, he was walking. Vet staff felt that the next step was to increase his opportunity for mobility. It was decided that the pair could be reintroduced to the colony. Keepers discontinued physical therapy and relied on Leroy's walking to continue to build his muscle mass. Modifications were made to his living space including: moving his nest box, removing a six-inch front from his nest box, and building a ramp into his box. All of these things were done in attempts to make life in the nest room easier for Leroy. The new location of his nest box was away from a dominant male penguin that could potentially pick on him and steal his mate. The new location was also closer to the door outside and provided more room for his ramp. The ramp was a small piece of fiber grate with a Nomad® Mat zip-tied to it. Leroy's nest box was also temporarily fitted with a Nomad® Mat rather than the normal substrate of recycled paper chips. This was done to provide a better grip until he adjusted.

Today at 18, Leroy is still alive and thriving in The Maryland Zoo's colony. He continues to breed and live with his mate. He no longer needs the ramp and is back to using the paper chips like all the other penguins. He continues to use a nest box without a front, decreasing the normal jump of about eight inches to a hop of about two inches. He also receives a brick to help his entrance and exit. He spends more time in his nest box and lying outside it than he did in the past, but also never misses his morning swim in the moat. Leroy's mobility is still limited, but leaps and bounds from where he



The modified nestbox and ramp Leroy used when initially reintroduced into the colony.

could not be determined. Vets explored every avenue possible in order to find answers as to why and what could be done. Their decision to treat him with steroids carried the significant risk of exacerbating a possible aspergillus infection, but it is believed to be a significant part of what saved his life. With close monitoring he showed minimal side effects from the drugs. It is not often physical therapy is thought of as an option or answer in avian husbandry. It was these unconventional treatments, a tremendous amount of hard work, and a little bit of faith that made this story a success. Without a doubt, Leroy holds a special spot in the hearts of everyone involved in his case - it would be a lie if the keepers told you he never received special treatment.



once was. The only other negative effect observed since his paralysis is his lack of molt this year, which may have been a side effect of the steroid administration.

Throughout Leroy's ordeal never once did his appetite, overall strength, and mental will suffer. He acted as if he never skipped a beat despite losing mobility in his legs and feet. It was Leroy's obvious will to live and perseverance that inspired The Maryland Zoo staff to never give up on him. He showed staff little by little, day by day how strong he truly was. This tragedy could not have happened at a more chaotic time at Rock Island, yet staff methodically pushed through each day. From the day Leroy's paralysis was discovered to the day he was released into the colony, staff rode a rollercoaster of emotions. The rarity of the injury left staff clueless as to what the outcome of this case would be. Leroy would not be alive today if it was not for the persistent and courageous vet staff. Although trauma is assumed the cause of paralysis, a definitive cause



Leroy's first trip outside after three months was successful, but he still had significantly hunched posture.

#### Acknowledgements:

I'd like to thank all the veterinary staff involved in this case; Ellen Bronson, DVM, Allison Wack, DVM, Donna Magid, MD, M. Ed., and Ariana Siemsen, DVM. And a very special thank you to those who invested so much hard work, and never gave up on Leroy: Ellen Bronson, Allison Wack, Jennifer Mignone, Betty Dipple, and Barbara Howard.

**At left:** Leroy today in the colony with his frontless nestbox and brick.

*Photos provided by the author.*



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# **Development of an Aviary Training Program: Enhancing the daily management of Zoo Atlanta's bird collection**

*By Jennifer Brink, Keeper II and Katie Bagley, Keeper II  
Zoo Atlanta, Atlanta, GA*

Managing free-flight birds in aviaries can be challenging but very rewarding. Traditional avian management has been relatively hands-off with the primary close interactions between human and bird occurring during stressful capture and restraint procedures. Many collection birds are distrustful of humans and may exhibit signs of stress while in small areas or in close proximity with caretakers. Following the guidelines of Zoo Atlanta's behavioral management philosophy and the constantly evolving zoological standards of animal husbandry, Zoo Atlanta has established a training program in both mixed-species and in smaller species-specific aviaries. Even in active breeding situations this progressive approach is allowing for closer daily management, has reduced stress and has lessened the need and frequency for stressful capture and restraint.

The training programs incorporate the use of a basic stationing behavior through the use of movable shape stations. The use of a stationing behavior in daily husbandry allows for closer observations, easier shifting and crating, and increases animal/keeper trust, while mentally stimulating and enriching the birds. As we develop new management techniques within the zoological field, we can facilitate a less stressful environment that can benefit staff and birds alike. This paper looks at how we, as animal managers, can improve avian husbandry through training in variably complex breeding and exhibit environments.

## **Introduction**

Animal care specialists, regardless of species expertise, share a common goal; to give the best possible care to those animals in our charge. Captive species are completely dependent on our abilities and efficiencies for their care. In the last 20 years zookeeping has changed significantly and today more attention is focused on behavioral management. This provides increased mental and physical stimulation for the individuals and has allowed for improved husbandry practices. As animal care specialists, modification and ongoing improvement of our techniques should be a priority.

Working with exhibit and breeding birds can be demanding in itself and establishing behavioral management strategies on these collections poses an even greater challenge. Unlike many other species, most exhibit birds have historically had very little positive interaction with their caregivers, beyond being deliverers of food. Many of our established relationships are negative. At Zoo Atlanta we are hoping to change these relationships through progressive management using training. Some beliefs held about bird training have been that: interacting with the birds encourages some species to bond with humans rather than potential mates and thus negatively affect breeding programs; that training is not worth the time investment since many birds are able to be netted and restrained very easily; that keeper presence in the exhibit is stressful on the birds and husbandry should be done quickly by servicing the exhibit and leaving. Especially during capture, our reliance on nets results in mistrust of caretakers, stressful environments, and potential injury to the birds.

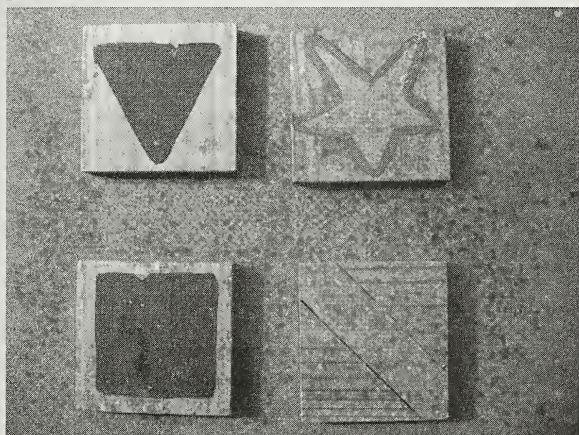
Zoo Atlanta's bird staff does not feel this hands-off approach, although respected and followed in appropriate situations, needs to be the rule. We are currently establishing a training program based on positive reinforcement for our exhibit bird collection. This paper focuses on Zoo Atlanta's Kori bustards (*Ardeotis kori*) and multi-species walk-through aviary. In conceptualizing the training program, our primary focus was to provide our birds with a healthier and more enriching lifestyle while improving husbandry techniques that would not interfere with breeding programs. Since implementing this program, we have discovered many other benefits including motivating and inspiring staff as well as educating the public about bird intelligence, behavior, and physiology.

## **Husbandry Benefits**

One of the target areas for our training program is a free-flight, walk-through, African aviary. Fourteen different species ranging from Taveta weavers (*Ploceus castaneiceps*) to Crested guinea fowl (*Guttera cristata*) currently live in this exhibit. The program was established to improve husbandry in a complex environment containing many birds. While some individuals are comfortable being seen and easily observed, others are more apt to distance themselves should a keeper enter their area. This makes it very difficult to observe all animals closely and to fully understand their behavior,

breeding habits, and physical condition. Since our program's inception, training has provided us with much closer inspections of physical issues. Each fall, many of the non-cold tolerant species also need to be brought into a building to spend the winter, forcing the birds into much closer proximity to one another and also the keeper. This creates a more stressful environment for those already predisposed to avoid keeper staff. Through training, we are able to target and successfully shift individual species into and between indoor holding spaces without the use of nets, thus decreasing undo stress to the individuals targeted and others residing in the same exhibit.

Each species was designated a moveable, colored shape platform that would act as their station. Ultimately, the species would recognize their station and fly down to it from anywhere in the aviary. The established behavior can then be used to encourage or train other behaviors, such as shifting, crating, and voluntary weighing. This behavior has allowed easier daily monitoring of the group. We have found this especially useful when it comes to medicating individual birds in a group setting without having to restrain, separate, or remove them from display. It has lessened the need for pulling individuals for a period of treatment and largely does away with issues that may result from needing to re-introduce an individual back to the group. This approach may also decrease a bird's susceptibility to diseases where stress can be a contributory factor.



Movable, color-coded shape stations

As with our mixed-species aviary, working with birds in single species exhibits has also proven beneficial. Through our program, we have been able to get weights on the Koris as often as needed, as well as successfully shifting them into holding as needed without having to herd them. In congruence with a goal of the Kori SSP®, we are working to see a valuable correlation with behavior and seasonal weight fluctuations that would not be feasible without our training program.

Since beginning this program the birds

have shown significant behavioral changes in the presence of keeper staff and are visibly more relaxed.

### Motivating Birds

When beginning any training program it is essential to determine the animals' motivation to participate. Birds that are pursued and captured using a net most likely equate the situation to being pursued by a predator. Uncomfortable handling by caretakers typically follows the initial capture. As exhibit birds have generally all had the experience of being physically restrained and/or caught with a net multiple times, they likely associate fear and discomfort with their caretakers. Several motivational aspects, including bird/caretaker relationships, inter-specific and intra-specific relationships, timing of training sessions, environment, and food availability, as well as its use as a reinforcer, need to be addressed when beginning a training program.

Bird/caretaker relationships: The relationship between bird and keeper is extremely important. Establishing this relationship is underlined by the understanding that everything done in caring for these animals is in some way training. Creating a successful program relies on noticing your behavior and actions along with the birds' responses and capitalizing on that knowledge. Through the use of enrichment items and training opportunities throughout the day, the amount of negative interactions between keepers and birds can be decreased thus creating a more trusting and calmer environment.

Inter-specific and intra-specific relationships: Determining dominant or aggressive animals is important. Focusing training on dominant individuals first avoids inter- and intra-specific aggression. By doing so, less dominant birds also become more motivated to participate after watching the others getting rewarded. Throughout the training process we continue to observe hierachal changes that are associated with breeding status, numbers of individuals in a species, and seasonal enclosure changes. This aspect is not seen as a training deterrent, but allows us to increase our understanding of the social



Gold-breasted and Superb Starlings stationing.

dynamics, as some behaviors may not have been as noticeable prior to training. These shifts in dominance are a constant challenge and training approaches need to be modified with the societal changes within the exhibit/enclosure.

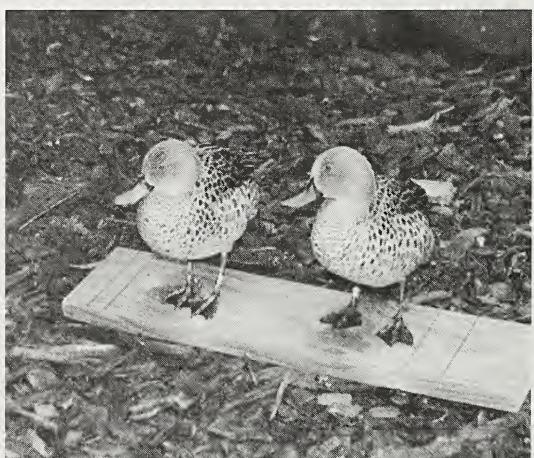
Timing of training sessions and food: Timing of training sessions is extremely important when establishing a program. Initially, sessions were held first thing in the morning when the birds were relaxed and highly food-motivated. As weight management is not used as a training tool, favored food items are withheld and used for the training sessions. Eventually we were able to establish a late morning training presentation and keeper talk. By doing so, we were able to capitalize on keeper time by successfully combining husbandry needs with the demands of zoo promotional initiatives.

Environment: During the course of our training we have found that the birds' motivation to train is sometimes challenged by the exhibit and environment in which the birds live. Continually evaluating bird behavior and their exhibits plays an important role in training programs. As many bird exhibits are not planned and built with training programs in mind, minor modifications are necessary to encourage a more inviting environment for the birds. Physical and behavioral barriers resulting from their environment affects the willingness of the birds to train. In establishing a training program, it forces keepers and curators to evaluate the animals' environment. Training can only occur if the trainee is calm, comfortable, and motivated. In proceeding with our training programs we found that adjustments needed to be made to exhibits and husbandry to create a more comfortable environment. Simple steps made in the Kori husbandry included removing visual barriers from their indoor holding area and providing a heat pad on exhibit to lessen the need to lock them inside during inclement weather. These adjustments, along with others, opened up a greater training window and also prompted keepers to research more about the species. This research inspired a change in husbandry and encouraged a more inviting environment in which the birds can live and thrive.

Many birds are highly sensitive to changes in their environment. When observing the birds in the walk-through African exhibit and in their winter holding, we observe many approaches made by the birds to their station and crate: direct flights, perch-to-perch, hovering, and walking. Moveable stations are advantageous in these situations because we are able to position the station based on the approaching behaviors of each species. For example, the Superb starlings (*Spreo superbus*), fly directly to their station while in the aviary but hesitantly hover over the station inside winter holding. Positioning the station near staggered perches increases their comfort and motivation level. This method also helps to decrease interference from species that approach the stations in other ways. It also taught the keepers much more about these specific birds allowing us to improve exhibit set-ups in regard to perching. We were then also able to provide more accessible nesting areas, and better feeding opportunities.

### Breeding

An active and controlled breeding program is generally essential to support a zoo's mission,



Cape Teal on station.

and is consequently of high importance. Some of us in the bird community have had concerns about the possible negative effects of training on breeding birds. Will it create bird/human bonds that could interfere with pairing? Will it damage existing pair bonds? Is it safe to train birds while they are actually breeding? Training can, in fact, do the opposite of interfering. When done properly it can benefit and encourage without impacting pair bonds. Through training, the birds in our care are developing a mutual trust with us. This trust appears to lessen the amount of stress they feel in our presence thereby calming their interactions with their mate and allowing for more accurate physical and behavioral observations by keepers.

Prior to implementing our training program we established protocols in an attempt to ensure that breeding and pair bonds were not impacted. To keep the pair bond between the birds solidified, hand feeding is not permitted. Reward items are generally tossed or dropped to the bird. During rearing season, birds are left with a constant supply of all food to ensure pairs can feed their growing chicks. Since establishing our training, our breeding program has continued to be successful. During nesting and rearing season, birds continue to participate in their training in a modified form. Sessions were restricted to the mornings, and adults would take their food reward to their respective nests to feed their chicks and/or mate. Multiple chicks from several species have been reared since the program began including Superb starlings, White-headed buffalo weavers (*Dinemellia dinemelli*), and Violaceous turacos (*Musophaga violacea*).

A male Buffalo weaver with a history of aggressive behavior had been trained to enter a shift cage prior to being introduced to his current mate. Once introduced to each other they soon nested. When the pair began rearing a chick, he was no longer asked to perform this behavior. After the chick fledged, keepers were able to quickly re-establish his shifting. Currently he, his mate, and his 0.1 offspring are all involved in the aviary station training with no change in behavior or pair bonding shown.



Gold-breasted Starling looking into crate

#### In addition to observing calmer

behavior from pairs, we have also noticed added benefits with their chicks. Offspring that have been reared with the training program in place have been taught through their parents and are markedly calmer. Although uncertain about how training impacts breeding programs of all avian species, some of our most successful breeding pairs this year were involved in training. All breeding pairs involved in Zoo Atlanta's program continue behaving normally with those in their social group and are successful breeders. When used judiciously we believe that we should be able to avoid negative outcomes to our training and still produce excellent, calm exhibit/breeding birds.

#### Staff Impact

As with any facility, Zoo Atlanta keepers deal with a multitude of species and exhibits and time is extremely valuable. Finding and justifying the time to train can be challenging. As such, establishing priorities within a departmental training program is extremely important. Larger multi-species exhibits and less easily handled species have been given priority over single-species aviaries. While time may be limited, training is not impossible. Our training program began with just a few minutes each day trying to capitalize on the bird and trainer's motivation. In the long run, these few moments out of the day can have very important staffing benefits. Eliminating or decreasing the number of personnel needed to capture a bird can increase productivity and efficiency of the staff. Since implementing our program, there have been multiple occasions on which a single keeper accomplished what had previously taken multiple keepers.

While this type of training shares similarities with other training programs, it has its own set of challenges providing an opportunity to inspire and motivate keepers to continually search for better

ways to care for and understand species that they train. As with many other professions and careers, employees who are not challenged or inspired can become dissatisfied and move towards other jobs and companies. High quality staff members are those who contemplate and question techniques, and modify them to better the quality of husbandry they provide. These behavioral management programs require keepers to research, learn, and understand psychological and physical aspects of the birds while teaching valuable problem-solving capabilities. Although this is not the primary focus of the program, when challenged and inspired and rewarded many keepers do put forth more effort into their work. Many staff love training and the benefits are not confined to the birds. Training is a huge motivator for many people. It can be enrichment to humans and animals alike.

### **Public Programming**

At Zoo Atlanta, as with many other institutions, there has become a growing demand on keepers for improving and increasing guest interaction. It is our responsibility as animal keepers and managers to provide and promote high-quality animal husbandry at our institutions. It is our responsibility as zoo employees to not only educate guests and support conservation, but to promote our institutions. More attention is being focused on guest interaction, entertainment value, and stay time at exhibits. The desire to follow Zoo Atlanta's initiatives, while not detracting from keeper work time, has resulted in keeper talks revolving around our bird training program. Both Kori and aviary training sessions are advertised events for guests. As animal caregivers it is foremost in our minds to be thinking about husbandry, breeding, conservation, and other messages we want to share with our guests. Many of our guests receive these messages best when they are being "entertained" by keeper/animal interaction that draws the animal into a more visible area. Most keepers involved in training are passionate about it and are therefore more likely to provide interesting and informative talks to the public. While formal surveys have not been done, it has been found that both of these programs have increased the guest stay time at the respective exhibits. Many docents have become involved as well; willing to stay and speak to the public about the importance of training in such complex environments. Not only have we seen guests become interested in the birds themselves, but it also prompts discussions about animal care in captivity and advances made in animal husbandry. During breeding season it has prompted discussions about SSP®'s, animal management in AZA institutions, and the improving husbandry standards. Our guests leave these talks and training demonstrations with an increased appreciation for birds of all kinds, their intelligence, social structure, and behavior; as well as a better understanding of zoos and their mission.

### **Conclusion**

As zoological institutions are continuously changing and evolving, so should our behavioral and husbandry management techniques. Behavioral management programs have become a strong focus within AZA facilities and are considered a basic part of most mammal husbandry. Bird management is lagging behind in this field. Although it may be possible to maintain adequate avian husbandry practices without the implementation of behavioral management programs, the benefits of it greatly outweigh the negatives. With the establishment of AZA's Standardized Guidelines for Animal Care it is timely for avian specialists to be looking at all aspects of our husbandry programs and determining better and more in-depth ways of managing and understanding our animals. Training is an important step toward that goal. Training programs benefit all those involved whether it is the birds themselves, keepers, management, veterinary staff, or even our guests. It is our responsibility as bird keepers and managers to not only maintain existing care, but to strive to set higher standards of animal care.



Gold-breasted Starling stationing.

*Editor's Note: The authors presented this paper at IAATE 2007 and AZA Regional in Denver 2007.*

*Photos provided by the author.*

# **Hand-Rearing Caribbean Flamingos (*Phoenicopterus ruber*) and Chilean Flamingo (*Phoenicopterus chilensis*) Chicks at the Birmingham Zoo**

By Paul Smith, Bird Keeper; Jeff Pribble, Zoological Manager of Birds;  
Cindy Pinger, Curator of Birds, Birmingham Zoo, Birmingham, AL

## **Introduction**

During the summers of 2007 and 2009 Birmingham Zoo received eggs from the collection flock of Chilean flamingos (*Phoenicopterus chilensis*) at Zoo Atlanta in Atlanta, GA. Thirty Chilean Flamingos were hatched and raised with a 76% survival rate. In 2007 we also received Caribbean Flamingo (*Phoenicopterus ruber*) eggs from the flock that resides at the Hialeah Race Track in Florida. Fourteen Caribbean Flamingos were hatched with a 93% survival rate. All of these flamingos were fed a diet that was created by Ellen Dierenfeld, Ph.D. and the Bronx Zoo.

## **Transportation**

Zoo staff transported the eggs to the Birmingham Zoo. The Chilean eggs were transported by car from Atlanta to Birmingham, approximately a two-hour trip. The Caribbean eggs were transported by car also but the trip was about 13 hours. The flamingo eggs were transported in an ice chest equipped with hot water bottles to maintain temperature. A digital thermometer with a long lead was placed at the level of the eggs with the display module outside. Inside the cooler we placed a layer of egg crate foam as a cushion. We used smaller pieces of cut foam to help provide protection between the individual eggs. Another layer of foam went on top of the eggs for further padding and as insulation.

The container was maintained at a stable temperature of around 98.5°F [36.9°C] for the duration of the trip from Atlanta to Birmingham. Upon arrival at the Birmingham Zoo the eggs were transferred into an incubator.

## **Incubation**

Flamingos typically incubate for approximately 28 -30 days. The incubation temperature for Chilean flamingos is 98.49°F [36.94°C] with 60% humidity. The incubation temperature for Caribbean Flamingos is just slightly higher at 98.6°F [37.2°C], with a humidity of 60%.

The chicks are very vocal in the egg right before hatching. Calling back to the chick in the egg may help stimulate hatching. Once the chicks entered the air cell, their egg was moved from the incubator into a hatcher. The chicks typically hatched within 24-48 hours after entering the egg air cell. Hatcher temperature was kept slightly lower than the incubator temperature, approximately 98°F [36.67°C] and 80% humidity.

## **Diet**

In the past when hand-rearing flamingos Birmingham Zoo has used a diet formula consisting of cooked egg yolk, cereal and fish/krill blended together. That diet was adjusted as the chicks matured into three variations gradually reducing, and then eliminating, the cereal and egg yolk portion. However we have had success in recent years with a much simpler formula, based on that used by the Bronx Zoo:

• Whole hardboiled egg (1 whole egg)	50g
• Hardboiled egg yolk (4 yolks)	100g
• Water	150ml
• Calcium Carbonate (high purity)	2g
• Vitamin E supplement	20-25 IU

This diet provides 58% fat, 32% protein, 1.3% calcium, 0.8% phosphorus (DM basis), at 23% solids. Calculated energy content of this revised formula is substantially higher than earlier formulas due to the increased fat level, and should support normal growth and development. Due to the fact that egg is the exclusive protein source, no limiting amino acids are detected and this protein should be of highest quality and balance for growing chicks (Dierenfeld, 2005).

This diet tends to harden in the chick's crop if the formula is too thick and/or the chicks are dehydrated. We increased the amount of water in the diet as necessary. We added an extra 10cc to 50cc of water (depending on volume of the batch) per batch for the first couple of weeks.

Do not feed a chick that has a food lump in its crop. Gently massage the crop to break up the lump as much as possible. Give water instead of diet at scheduled feeding, more often if necessary. Water should be administered between feedings if a chick has been having continued problems with food lumps as this could be a sign of dehydration.

### **Feeding**

The chicks were fed using syringes with catheter tips with flexible catheters attached. For these early feedings, a 10cc syringe was used, but it quickly became necessary to move up to a 60cc syringe. This larger size was used through the weaning process. The catheters were cut to varying lengths depending on the bird's size. The cut ends of the catheters were gently heated to round the sharp edges before its initial use.

Feedings initially occurred roughly every two hours starting at 0800hrs and ending at 1700hrs. The feedings started as soon as the chicks metabolized the internal yolk sac. This took between 12 and 24 hours after hatching, although fluids were given before this when dehydration was a concern. The formula was heated to around 36°C (96.8°F). The chicks will refuse food if it is too cold and there is a risk of burning the crop if it is too hot. When feeding, the crop was filled until it was almost completely full. Avoid filling the crop completely as this increases the risk of aspirating into the lungs. This was mainly a concern during the first couple of days since a swallowing response in many of the chicks is not yet developed. Feeding response was usually gained by touching the side of the bill with the feeding tube. The chick opened its beak and the tube was placed down the throat passed the tracheal opening. There was a stronger swallowing response when the chick was standing with its neck held straight. This was accomplished by holding the thumb and index finger around the bill and once you had a feeding response then gently tilting the chick's head. In our experience the Caribbean flamingos became more comfortable with this feeding method than the Chileans. As a general rule, they were much more prone to struggling and trying to avoid the tube. This was not a significant problem as the chicks still exhibited signs of hunger and early feeding responses. It merely required a slightly firmer hand when holding the Chilean chick's head.

Feeding frequency was reduced to four times a day at around seven days of age. At 14 days old we went to three feedings a day. At this point shallow pans of water with flamingo pellets were provided and most of the chicks began learning to filter feed within three or four days. It is important to feed a diet rich in calcium for at least the first year. At the Birmingham Zoo we feed Mazuri® Flamingo Breeder year-round.

As long as weight development remained on track (approximately a 10% gain per day) feedings were dropped to twice daily at 28 days. The average amount of formula per feeding at this stage was 60cc. Chicks were reliably filter feeding at this age so the keepers were tube feeding on a more supplemental basis. At just over a month old most of the chicks were reduced to a single feeding a day, and by 42 days of age all tube feeding was stopped. There were a couple of chicks that required one or two additional feeds in the days that followed when weight gain began to fall behind, but all chicks were fully self-feeding by this time.

Days Old	Number of Feedings	Hours Between Feedings
1-7	5	2
8-14	4	2.5
15-28	3	4
29-35	2	AM and PM
35-40	1	Mid Day

### Housing

For brooder boxes we used plastic boxes measuring 18" wide x 24" long x 14" deep [45.7cm x 60.9cm x 35.6cm] with the soft, rubberized drawer liner (Grip-It® Shelf & Drawer Liner) cut to size to line the bottom. This lining material is easy to clean, soft on the chicks feet and provides enough grip to allow the chicks to move about comfortably. Additionally, 250-watt heat lamps were hung above the boxes at varying heights to allow keepers to control the brooder temperature, kept at around 98.06°F [36.7°C] for the first few days and then gradually reduced to 93.02°F [33.9°C] by Day 7. By Day 14 the temperatures were held near 89.96°F [32.2°C] and reduced 84.92°F [29.4°C] by the Day 22.

We found that aggression became an issue if more than four chicks were put in a brooder box together. Aggression was particularly a problem between chicks of significantly different age/size. My anecdotal observation was that the females were more aggressive than the males, but perhaps this was unintentional chauvinism on my part. As the chicks grew and became more aggressive, certain problem chicks were housed separately.

Once the chicks were too large to be housed in brooder boxes, approximately four weeks of age, they were moved into our flamingo holding facility in an area sectioned off from our resident flock. This provided the chicks not only with more space to move and larger basins for feeding and bathing, but also allowed them to be near and interact vocally with our adult birds. Both groups were allowed to observe each other for a week before the chicks were integrated with the adults during the days. For a couple of weeks the chicks were placed back into the original holding area separated from the adults overnight. After this two-week introduction period the chicks were left permanently in with the adults day and night.

### Husbandry

Each chick was fitted with a number five size plastic band for identification. Since the eight chicks that survived hatched several days apart from each other it was easy to tell them apart for a little while. The bands were eventually necessary at around a week old. These bands were increased in size two more times during the chick's development while at our facility. Pinioning was done between seven and ten days of age. At the Birmingham Zoo we use the long pinioning technique on all of our flamingos.

Starting at seven days of age, the chicks were taken out into an exercise yard for two, half-hour intervals daily. The exercise yard was a section of lawn set apart from other animal exhibits but viewable by the public visitors to the zoo. In the past, when hand-rearing the Caribbean flamingo chicks we had a fenced off area used as an exercise yard. We found that the Chileans were less likely to stray from the keeper and tended to stay closer to each other, so we did not fence their exercise area.

The chicks had a tendency to eat anything that they could pick up, so the area was kept as free of leaf litter and detritus as possible. If a chick ingested too much of this material it could have caused crop or intestinal blockage. During these exercise sessions the birds were supervised by at least one keeper, and even with a relatively clean yard it was often necessary to remove objects from their mouths before they could swallow them.

Daily bathing was needed to keep the birds clean, so shallow tubs of water were provided during exercise sessions. Because chicks were slow to take to bathing themselves, they were frequently bathed by the keepers.

## Growth and Development

Once the chicks began to gain weight, they did so at approximately 10% of their body weight per day. (Figure 1 and Figure 2) The first couple of days it is normal for them to lose weight. The chicks were weighed daily to monitor growth and development.

We did have some medical issues arise in the Chilean flamingos that we did not see in the American Flamingos. Within the first couple of days after hatching we had nine chicks develop symptoms of a curvature in the neck where they could not hold their head upright. The head was positioned in a way that it was looped around and they were looking at the ceiling. It was determined that this was a bacterial infection and a two-week treatment of Nystatin and Baytril was started with much success.

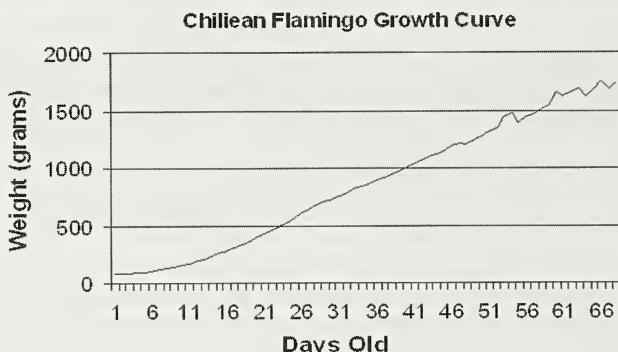


Figure 1: Average Growth for 21 Chilean Flamingos

## Conclusion

Flamingos can be time-consuming to rear but they are not difficult. It is always best to watch your animals and provide them with what they require. Amounts that are fed and brooder temperatures can change depending on the individual bird.

## American Flamingo Growth Chart

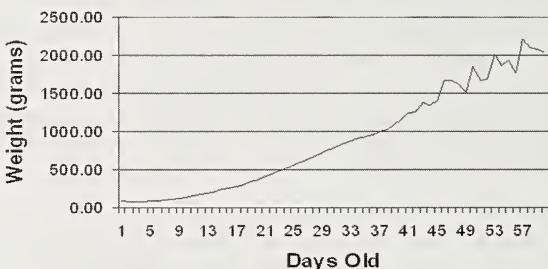


Figure 2: Average Growth for 13 American Flamingos



Chilean Flamingo Chick at 14 days of age. (Photo by Alan Yester)

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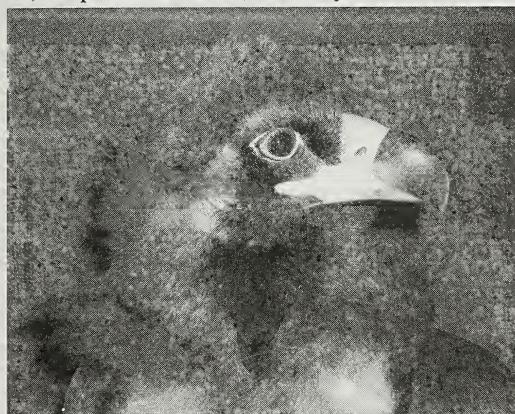
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# Breeding Cinereous Vultures (*Aegypius monachus*) at The Milwaukee County Zoo

By Dawn Wicker, Area Supervisor, Winter Quarters  
Milwaukee County Zoo, Milwaukee, WI

Cinereous Vultures, or Eurasian Black Vultures, (*Aegypius monachus*) are large vultures native to parts of Europe, Northern Africa, the Middle East, and Asia. It is estimated that there are less than 10,000 pairs in the wild; thus they are considered "Near Threatened". One main threat is mortality at the hands of humans. They are sometimes deliberately killed, and they also consume poisoned bait intended for other predators.

The decline of available food is another major problem.



Cinereous Vulture (*Aegypius monachus*)

In the North American collection, there are slightly less than 50 of these birds held in 23 institutions. The TAG recommended population is 75 individuals. Unfortunately, despite the number of recommended pairs, there has been a low production of viable offspring. Broken eggs, infertile eggs, chick death in the shell, and death early after hatch are all problems.

The Milwaukee County Zoo has had Cinereous vultures since at least 1970 when three wild-caught birds were acquired. Unfortunately, all three individuals were males. In the mid-eighties, under the direction of then-Curator of Birds Ed Diebold, a breeding program was developed. Although there were some early struggles, including one incorrectly sexed bird, a chick was hatched in 1988. This chick was hand-reared, and was sent to the Lincoln Park Zoo in Chicago in 1989.

Here at the Milwaukee County Zoo, Cinereous vultures are exhibited in a mixed-species exhibit with Impala (*Aepyceros melampus*), Gazelles (*Gazella dama*), and Sulcata Tortoises (*Geochelone sulcata*) from approximately mid-April through October, depending on the weather. In the winter, they are set up off-exhibit in pairs for breeding. Over the years this has been done in a variety of places. In the late 80's and early 90's, Cinereous vultures were usually wintered outdoors. They had a fairly good-sized yard with a lean-to shelter inside it. Because the food and water would freeze, the birds were tended to twice daily.

By the mid-1990s, the vultures were generally housed for the winter in "Bird Winter Quarters", an indoor area connected to the Zoo's then-Hospital. One female had a joint problem in one leg, and it was decided that it might be too cold for her outside. Large cyclone fence enclosures with concrete floors were set up with breeding platforms, approximately 4'x4' [1.2m x 1.2m] and about 2' high [.60m]. The birds were in relative seclusion; a keeper came once a day to feed and clean, and then the birds were left in peace.

Starting in 2004, the Cinereous vultures have been kept in the same underground barn as the animals with which they share the exhibit yard, called "Winter Quarters." It is a misnomer, as the residents are here year-round; but most of them don't go on exhibit during the winter months. What many "bird people" find amazing is that they are now also cared for not by bird keepers, but by the same keepers who take care of their hoofed and horned neighbors!

Our current birds are:

Male #81, "Grimm", a parent-reared bird from Palm Desert, hatched in 1999  
Female #76, "Cruella", hand-reared at Birmingham, hatched in 1998

Male #71, "Triton", parent-reared at Columbia, hatched in 1996  
Female #70, "Poseidon", hand-reared at Oklahoma, hatched in 1996

Female #101, "Eve", hand-reared at Birmingham, hatched in 2006 and a full sister to "Cruella". She is not currently paired.

Cruella arrived here in 1999, and was originally with her brother "Lurch" (#73), who was already here. They were allowed to "grow up together", but they started showing a strong pair bond even at a very young age. Cruella laid an egg in February 2005, even though they were not set up for nesting. The egg broke. Lurch was shipped out and replaced with Grimm, who arrived in May 2005. They took to each other right away. At the time, they shared the exhibit yard with a pair of Lappet-Faced Vultures (*Torgos tracheliotus*) and a pair of Ruppell's Griffon Vultures (*Gyps rueppellii*), as well as a young Ruppell's, in addition to the hoofstock.

The newly paired birds were set up for the breeding season in an approximately 8' x 16' [2.43m x 4.87m] enclosure with floor-to-ceiling walls. They were given a nesting platform, and everyone hoped for the best. Unfortunately, as well as they got along in the exhibit yard, they did not seem to appreciate the closer quarters. Cruella would not allow Grimm to share the nesting platform, but he seemed content to stay on the floor – most of the time. They were given an additional platform and an extra stall space, and they got along better for the rest of the winter, but did not nest.

They were on exhibit together the summer of 2006, and seemed to strengthen their pair bond. They spent most of their time together, often preening each other. By the end of summer, they were presenting each other with sticks, and even built a "nest" in the exhibit yard.

That winter, 2006/2007, they were housed in a larger enclosure. Our male zebra had died, and his barn, approximately 25' square [2.32 sq. m], was vacant. They were given a nesting platform, but were not really set up to breed. They were not recommended that year for genetic reasons; thus they were not given the typical loads of sticks and straw for nesting. They surprised us and laid an egg in February 2007, which was found on the ground, broken and partially eaten. The SSP® recommended that they be given more (lots more!) nesting material and they re-laid on 22 March. Unfortunately, that egg disappeared on 31 March.

Triton and Poseidon arrived at the Milwaukee County Zoo from the Racine Zoo in October 2007. After quarantine at the Animal Health Center, they arrived in Winter Quarters in mid-November. They had been together at Racine since 1997. They had laid one egg there, but it had been broken. Since they were so compatible, we set them up in the space that Grimm and Cruella hadn't done so well with in 2005/2006. They did get along fine, but showed little interest in sticks or straw. Moving twice that fall – first from Racine to Milwaukee, and then from Quarantine to Winter Quarters, might have been a factor.

Grimm and Cruella spent their second winter in the old Zebra Barn. At this point in time we were without a Curator of Birds, and Grimm and Cruella did not have a strong recommendation to breed, so they were again not really "set up" for breeding. They had a platform, and there was straw in the barn, but they were not given much in the line of sticks. Our new Curator started in February of 2008, and he instructed us to go ahead and give them sticks. They were given an armload of sticks at least twice a week, and they incorporated them into a nest on the ground. On 26 March, they were sitting on an egg. Per recommendations, it was pulled on the 27th and replaced with a dummy egg. Grimm and Cruella shared "incubation" duties until late April, when they were put back on exhibit for the summer. The real egg was not artificially incubated.

By this time, Cruella's sibling, Eve, had also arrived at the Zoo. The five birds got along well on exhibit. Although there were interactions between all the birds, the paired birds would generally be

near each other most of the time, especially Grimm and Cruella. The birds were brought in a little earlier than usual that year because of a colder-than-usual Fall. We also changed accommodations around for the winter of 2008/2009.



Triton and Poseidon on a nest platform in the Zebra Barn.

Triton and Poseidon got the old Zebra Barn. They are the pair that has the higher priority to breed, so we gave them the location where Grimm and Cruella had laid eggs in two years in a row. They were given two nesting platforms, and “boatloads” of nesting materials beginning in mid-October.

Grimm and Cruella were still not highly recommended to breed, so they were housed in an empty hoofstock stall, about 8' wide by 16' deep [2.43m x 4.87m], with one 4'x4' [1.2m x 1.2m] platform. While in the past, we had tried to set vultures up in quiet locations with little disturbance, this stall was across the hall from a main workstation. As they began nest building, we realized that the area was too narrow.

When they perched side by side, one would

often knock the other off the perch. Fortunately, all of our stall walls are movable, and we merely created a double-wide stall for them, about 16' x 16' [4.87m x 4.87m].

Both pairs were given sticks and straw for nesting. If one has not worked with nesting vultures, one cannot comprehend the quantity of sticks that these birds can incorporate into a nest – and how many more just “aren’t right” and don’t get used. In the early stages of nest building, it seems somewhat thicker sticks are preferred – about the diameter of a finger or thumb, and 2 to 3 feet in length [0.60m to 0.91m]. Once the foundation is set, they seem to prefer a thinner diameter stick, but still want the occasional sturdier stick here and there. We store sticks in feedbags, and offer a feedbag-full twice a week or more once the birds really start in on the nests. Straw and timothy hay are also offered, and once the nest is nearing completion, the birds like softer materials, like long needled pine boughs. We have also given them bamboo leftover from our Red Panda (*Ailurus fulgens*).

Grimm and Cruella nested on their platform. Triton and Poseidon started to build one nest on a platform, but then decided to move down to ground level.

One advantage to having Grimm and Cruella in a main work area was that we could hear – and see – copulations. By February 2009, they were copulating as often as every 70 minutes. On 5 March, they were on an egg. Unfortunately, on 11 March, the egg was gone. We assume one or both of them ate it, but no shell fragments or any other remnants were left.

On 17 March 2009, Triton and Poseidon also had an egg. Their egg was pulled and replaced with



Grimm and Cruella in their 2009/2010 quarters.

Grimm is manipulating a stick.

a dummy egg. The real egg was taken to the Aviary where it was artificially incubated. The birds returned to the nest immediately and sat on their wooden egg. Keepers noted that both birds took turns on the nest.



The beginning of Grimm and Cruella's nest.

For reasons known only to the birds, in late April Poseidon moved their dummy egg eight feet [2.43m] along the rear wall of the Zebra Barn, and had built a small nest up around it there. The egg was on the barn floor, though. We moved the dummy egg back to its original nest. The male incubated it there; the female sat on her new but empty "nest". The next day, she was on the egg in the old nest, but the following day, she had moved it back to her new spot. It was decided that we should let her stay there, but give her lots of material to make the nest better.

Their real egg internally pipped in early May, at 49 days. This confirmed that Triton and Poseidon, at approximately 13 years of age, were the youngest pair of Cinereous vultures to lay a confirmed fertile egg. We planned on giving it back to them when it externally pipped, but it never did. The chick was declared dead in the shell on 10 May 10 at 54 days. We hoped the birds would stay on their dummy egg in case we wanted to let them raise Grimm and Cruella's chick, to give them practice, but by 16 May, they were no longer interested in the nest at all. The nesting material was removed from their barn, they were given their spring examinations and vaccinations, and they were put on exhibit for the season.

Grimm and Cruella were still very attentive to their nest, and on 17 May, it was determined that their egg was still viable. It was returned to them on 20 May to let them hatch it. Being only 10 and 11 years old, they had just become the youngest pair to have an egg get to that stage! On the afternoon of 29 May, we could see that there was an external pip, and by the morning of the 30th, the chick had hatched. The pair seemed attentive, and they were given extra feedings. The chick was seen moving during one feeding, but we never saw the parents feed the chick. Unfortunately, the chick was found apparently dead in the nest the following morning. Grimm picked the chick up and removed it from the nest, jumping down to the floor and dropping it. The chick still had a large yolk-sac, which broke open on the floor. Neither adult bird showed any interest in the dead chick, and did not interfere with us removing it from the enclosure. Necropsy revealed issues indicating a difficult hatch, and a large, unabsorbed yolk sac, which was either torn by the parent or ruptured when the chick was dropped, but it could not be determined if the yolk sac broke before or after the chick's death.

Grimm and Cruella re-laid on 8 April; this egg was pulled and artificially incubated, and the birds were given a wooden dummy egg.

Both eggs were artificially incubated at the Aviary. Triton and Poseidon's egg tracked a 13% weight loss, but Grimm and Cruella's tracked at 8%, even though the relative humidity in the incubator was below 40%. Vulture eggs are thick shelled, and are therefore difficult to candle. Even ultrasound cannot always determine viability. Both eggs were incubated full term, even though no one was sure if they would hatch.



Grimm threatens as his patience with picture taking wanes.

What I find interesting, overall, is that while both our males are parent-reared, both our females are hand-reared, and yet both pairs did everything they needed to do. Also, Grimm and Cruella did it in a very "busy" location, rather than in the seclusion we normally think that they require. It is unfortunate that neither chick survived, but we are trying again this year. Triton and Poseidon have the Zebra Barn again, and are already well into nest building. Grimm and Cruella are in the area they didn't use in 2006, but it has been remodeled to twice the size. They are a few weeks behind the other pair in nesting, but they seem to be catching up. Wish us luck!

I would like to thank Ed Diebold, Kim Smith, and Alex Waier, past and present Curators of Birds, each of whom has contributed to our breeding program, and the other members of the Winter Quarters staff, Zookeepers John Durrell, Robert Collazo, and Craig Pavlik, who shared in the responsibilities for the daily care and monitoring of these magnificent birds.

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## Collaborators Sought for Study.....

### The Use of Vocal Playback as a Tool for Breeding in Captive Birds

By Justin C. Hickman, Bird Keeper  
Tulsa Zoological Park, Tulsa, OK

Dr. Erik Terdal, Professor of Natural Science  
Northeastern State University  
Tulsa, OK

The study of bird vocalizations and how it relates to breeding is in its infancy with new information being discovered every day. This study will relate past research of bird breeding to help increase genetic diversity in captive bird populations found in zoos and aquariums. The purpose of this research is to study the behavior of two captive bird species in male/female enclosures during same species vocal playback. A pair of 1.1 Red-and-Yellow Barbets (*Trachyphonus erythrocephalus*) and a pair of 1.1 Plush-Crested Jays (*Cyanocorax chrysops*) will serve as the subjects of observation. Each species is housed on exhibit in single male/female enclosures.

The study is an observational study using vocal playbacks provided by Cornell University Macaulay Library and data will be recorded on an ethogram that has been developed for both individual species. The hypotheses is the introduction of species-specific vocal playback will have a positive affect on breeding behaviors in birds housed in male/female pairs. Due to the small size of our study group we are asking for interested institutions to participate so our conclusions will be more valid and concrete. Any institutions that are currently housing Plush-Crested Jays and/or Red and Yellow Barbets and are interested in participating please contact: Justin Hickman by email [hickman@nusok.edu](mailto:hickman@nusok.edu) or by phone at Tulsa Zoo - Bird Department 918-669-6234.

The study will require two months of observation and would be conducted two times a week with each session lasting 20 minutes. All needed information and vocals would be provided.



Plush-crested Jay  
(Photo: [www.tropicalbirding.com/](http://www.tropicalbirding.com/))

# **AVIAN REARING RESOURCE WEBSITE**

For generations aviculturists have been hand-rearing birds, and over the years protocols have been refined and improved. However, this information is not always easily accessible and sometimes it is an art (albeit a time-consuming one) to track down the most up-to-date information. Only limited work has been done to measure the success of these protocols and the long-term effects on the health and breeding success of species that have been hand-reared; and at a time when it is vital that we all work together in an attempt to establish self-sustaining captive populations, it is more important than ever that if the decision is taken to intervene and hand-rear, it is done with the knowledge that the resulting individuals will be healthy and valuable additions to the captive populations.

Therefore, a new website - [www.avianrearingresource.co.uk](http://www.avianrearingresource.co.uk) - has been created to compile hand-rearing protocols, measure success rates, and highlight problems and the potential for research into improving protocols, as well as looking into the long-term survival and breeding success of hand-reared birds.

## ***Aims of the site***

The aims of this site are to compile current hand-rearing protocols for all species of birds, to highlight any problems in rearing individual species, and to make the site accessible to all and simple to navigate. Over time, it is hoped that by sharing information we can work together to improve the quality of hand-reared birds and minimize mortality. Using a rating system, the success of each protocol is measured, and there is a star-rating system for: the success rate, whether the protocol has been used successfully by two or more institutions/individuals, points and criteria for minimizing imprinting, whether the birds go on to produce fertile eggs, and whether the birds go on to successfully parent-rear their own young.

## ***Site content***

There can be as many as four or five different hand-rearing protocols for a single species, giving users a better idea as to which may be the best option for them. A protocol template can be found on the home page, along with the e-mail contact for any feedback, etc. A hand-rearing decision tree is included to encourage aviculturists to take the decision to hand-rear responsibly.

Additional information is also included, such as general information on species, articles about hand-rearing and husbandry guidelines.

The site is at present in its infancy and with help and input will evolve. All are welcome to submit protocols, which along with any comments or other feedback can be sent to: Louise Peat at: [avianrearing@googlemail.com](mailto:avianrearing@googlemail.com).

*Editor's Note: Louise Peat is the Registrar at Cotswold Wildlife Park in Burford, Oxfordshire, England.*

# Designing a Keeper and Bird-Friendly Enrichment Program

By Jennifer Evans, Lead Aviculturist  
Tracy Aviary, Salt Lake City, Utah

Many zoos have enrichment programs that look great on paper. They have clear guidelines and schedules along with documentation of the enrichment given. Procedures are in place to decide what enrichment items are acceptable and how to request permission to provide new enrichment items. We had an enrichment program just like that and our keepers hated it. The program was very time-consuming without being effective at providing the birds with meaningful enrichment. The Aviary re-vamped that program to address the individual needs of the birds in our collection.

## Natural History

We did keep several aspects of our original program, the first being researching the natural history of the species. The Tracy Aviary has always made it a goal to provide the birds under our care with as many aspects of their natural “wild” lives as possible. Enrichment is simply one part of that. Keepers complete a Natural History form for each species of bird under their care. This form looks at social structure, wild habitat, feeding strategy, diet, activity cycle, primary sensory modality, reproductive data and threats. This information helps the keepers to understand more fully the life any particular species would be living in the wild. They then use that information to compare the bird’s *in situ* situation versus what we are able to offer them at the Aviary.

## Individual History

The second step of our original program was to examine the individual’s history and housing situation at the Aviary. We look at the bird’s exhibit, medical history, behavioral history, diet and feeding schedule, social structure, and animal/keeper interactions. Keepers would then set enrichment goals based on behaviors they hoped to either increase or decrease. This part of the process at one time was simply a time-consuming exercise for the keepers as it did not play into the enrichment they were actually giving to the birds.

## Schedules

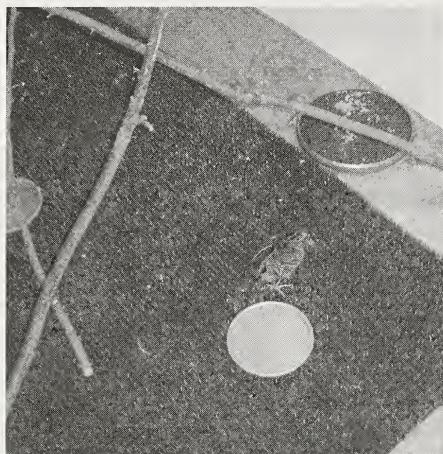
Schedules were designed based on species alone, not on the individual. Enrichment was based around five categories: sensory, foods and feeding, environmental, manipulative items/toys, and social/behavioral. These categories had to be rotated to ensure a broad base of enrichment offerings. Birds that were deemed more intelligent, such as a corvid or parrot, were enriched more frequently, every two days, while other birds such as waterfowl were enriched once a week. A keeper may set a goal of increasing natural foraging behaviors, but the program only allowed the keeper to offer food enrichment a few times a month.

## Individual Guidelines

The individual guidelines were developed to create a truly unique and individualized enrichment program for each bird at the Aviary. While completing the Natural History and Individual History is a time-consuming task for the keepers, the Individual Guidelines creates a far less time-consuming enrichment program. This program not only saves time but also focuses the enrichment on the birds that need it most. We kept the five original enrichment categories and added a sixth category of breeding/nesting. The Tracy Aviary feels strongly that for birds, nesting is such a huge part of their life that it cannot be ignored. For each individual bird or group of birds, if they live in the same situation at the Aviary, we compare their living situation to the enrichment categories.

## Sensory

Sensory includes visual, auditory and tactile and for most birds olfactory to a much lesser extent. All animals use their senses and birds are known for their primary use of sight and sound. Keepers examine the living situation of the individual to ascertain the amount of sensory input the bird receives from its living situation. For example, a bird living in an open outdoor exhibit is exposed to



Chick shown with foraging opportunities.

(Photo: Jennifer Evans)

foods several times a week on a rotational basis. The idea is simple. The birds are fed pellets in a pan in the morning when they are most hungry and many species naturally forage for food. Later in the day they are offered enrichment food items which vary from bugs and meat to lettuce and seeds depending on the species. These items are offered in a manner that encourages the birds to forage. This feeding style is taken into account when considering food enrichment in our overall enrichment plan. Birds that are on this schedule do not require further food enrichment. Birds such as raptors that are only offered whole food items in the same way everyday may require food enrichment.

## Environmental

Environmental enrichment is anything that changes the environment in which the bird is living. Wild birds change their own environments constantly, simply by moving to a different location. This may mean walking or flying a few feet away or a few hundred miles away. Captive bird's environments don't often change. There isn't much motivation to change an exhibit that is well perched and planted. In contrast, birds that live in open outdoor enclosures do see their environment change. This may come from the change in seasons, weather, the public or even the keeper. Birds living in holding spaces see almost no change to their environment. For example, while our flamingo flock must deal with snow and ice in the winter, going in and out of holding on cold nights, and plants growing and weeds being removed in their exhibit, a dove in holding may only have its perching changed a few times while it is in holding.



Holding space with food and environmental enrichment.

(Photo: Jennifer Evans)

## Manipulative Items/Toys

This is a category of enrichment that seemed to be largely wasted on many species of birds, although I imagine heavily used for mammals. Some species like parrots, corvids and vultures do use manipulative enrichment when provided. Many more species don't go near toys. In the wild they spend their days eating, preening, breeding and escaping predators. Natural history is the largest factor for us in deciding how often to enrich in this category.

the sights and sounds of the entire Aviary as well as, in many cases, the outside park as well. A bird living in a holding space sees the same thing day in and day out and hears only slightly more.

## Foods and Feeding

The foods and feeding category is self-explanatory. Finding food is how most birds spend a large part of every day. It is the keeper's favorite enrichment category. Give a bird its favorite treats and you are almost always guaranteed a positive reaction. The keeper's propensity to do food enrichment requires a good enrichment program to restrict the amount of enrichment food offered in order to ensure the bird is receiving a nutritionally complete diet. The Tracy Aviary decided to use a diet that was almost exclusively made up of pellets for most of the birds to ensure proper nutrition. This opened up the door to being able to allow keeper's to offer enrichment

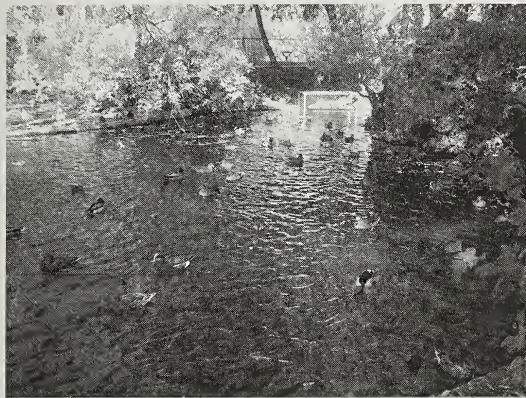


Exhibit needing almost no enrichment.

(Photo: Jennifer Evans)

pond. Waterfowl in holding obviously do not have all of these social opportunities and may require additional enrichment.

### Breeding/Nesting

Once a bird is breeding that becomes a singular focus for them. The Tracy Aviary does not breed every bird in the collection, but we do provide every bird with the opportunity to go through the experience - short of chick rearing. Breeding and enrichment are linked in different ways for different species and individuals. For a pair of swans providing them enrichment while they are building and defending a nest is unnecessarily disruptive to their breeding behavior, especially if you wish to have them rear offspring. During this period we focus all enrichment on providing them with more nesting materials and abundant food sources. For a pair of corvids providing intensive enrichment including, but not limited to, food enrichment can encourage them to breed or deter them from destroying their own eggs or offspring.

### Schedule

Once the keepers have compared each category of enrichment to the natural history of the bird and its individual living situation they can make a schedule of enrichment for the bird. Many of our birds living in groups or pairs in outdoor exhibits have most of their enrichment needs met. We know those needs are met so we are able to focus our enrichment time on birds in holding spaces or birds housed alone that do not have many of their enrichment needs met. This plan allows keepers more time to provide higher quality enrichment to the birds that really need it.

### Next Steps

This enrichment plan is in its early stages at the Tracy Aviary. The initial research is quite time-intensive so the going is slow. The Aviary is starting an Enrichment Volunteer program to help the keepers in their research of bird's natural history, the creation and preparation of enrichment items and most importantly the observation of the birds after they have received the enrichment. The extra help will hopefully allow keepers to focus on creating very individualized enrichment programs for the birds under their care.

### Social/Behavioral

Different species of birds have vastly different social structures. Some species live in flocks of thousands, others live in small family groups, and some live in monogamous pairs, while still others live alone outside of breeding season. Some live with many other species in close proximity while others live only with conspecifics. The Aviary attempts whenever possible to mimic these social structures. Good examples of birds in our collection that have their social needs well met are the waterfowl living on our main pond. They live with conspecifics as well as contraspecifics waterfowl and pelicans. In addition to the birds exhibited with them they also have wild passerines, waterfowl, and even predators visiting their



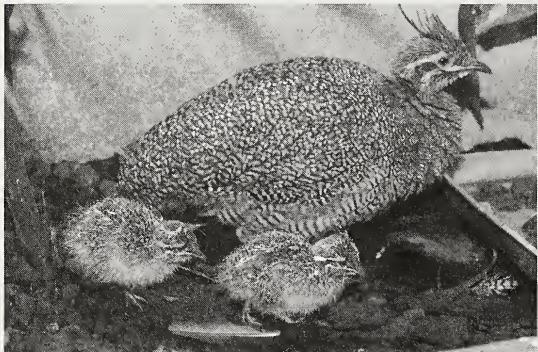
Birds in yard with manipulative enrichment.

(Photo: by Rebecca Bates)

# Successfully Raising Parent-reared Chicks from Elegant Crested Tinamou (*Eudromia elegans*)

By Reade Harbitter, Animal Keeper  
Smithsonian's National Zoo, Washington, D.C.

In October 2009 we welcomed our first successful Elegant Crested Tinamou chicks hatched at Smithsonian's National Zoo. The Bird House has been home to tinamou for many years; however we have not had a successful hatching until this year. The dam arrived at the zoo only five months ago and the sire is a first-time father. Elegant crested tinamous (*Eudromia elegans*) are smallish ground-dwelling birds native to Argentina and Chile. They have a compact build, with a small head, decurved bill, and grey and brown streaked plumage. As adults, the birds typically posses a long crest, normally carried backwards but raised forwards when excited. They are at home in arid and semi-arid grassland, dry savanna, open woodland, and dry Andean steppes. There are approximately 47 species of tinamous ranging across Central and South America. Most tinamous are not globally threatened while some species are critically endangered. All tinamou suffer from population decline due to habitat loss and hunting for food (Del Hoyo, 1992).



The male tinamou keeps close watch on two of his young brood. (Photo: Mehgan Murphy, Smithsonian's National Zoo)

There are 90 Elegant crested tinamous housed in 18 institutions across the U.S. The studbook data indicates that 38 chicks were hatched in 2009 and of those 11 were parent-reared. Not much information is available on parent-reared tinamous or Elegant crested tinamous in particular, however hopefully the techniques used at the National Zoo may be helpful to any other institution wishing to attempt parent-reared chicks.

The breeding season for Elegant crested tinamous is similar to that of other tinamous, June/August - November, with most laying

occurring during October. Simultaneous polygamy and sequential polyandry is typical, with the female laying 5-9 olive or yellowish shiny green eggs. Incubation typically lasts 20 - 21 days and is carried out completely by the male. This is similar to rheas and other ratites (Struthioniformes) which are thought to be closely related to the tinamous (Tinamiformes). Mortality rates are very high in the wild, and in the first few days of life chicks are especially susceptible to predation from wild cats, skunks, foxes, and raptors (Del Hoyo, 1992).

The male and female were introduced to each other in late July 2009 and after acclimating together for several months, were subsequently housed in a mixed-species exhibit visible to the public. Also in the exhibit were 1.1 Yellow breasted ground dove (*Gallicolumba tristigmata*), 0.1 Blue winged teal (*Anas discors*), 0.1 Ringed teal (*Callonetta leucoprys*), and 1.1 Fairy blue birds (*Irena puella*). The National Zoo has kept pairs of Elegant crested tinamous in the past, but has never successfully hatched chicks. This particular male has been with other females in different exhibits, but has never exhibited consistent incubation behavior and eggs never made it full term.

Parent-raised chick mortality is generally believed to be very high among Elegant crested tinamous (K. Clark, pers. Commun.). These birds are often kept in multi-species exhibits, so this may be due to aggression or predation from other species as well as parent competition or aggression. The pair at National Zoo was approved for breeding by the studbook keeper, so it was decided to go ahead and allow the male to raise the chicks but with no expectations.

Beginning in late September 2009, copulation was observed several times by animal care staff. The first shiny green egg was laid on 1 October in a small, leaf-lined depression in the gravel under a plant in the corner of the exhibit. The male spent most of his time on the nest, leaving periodically to eat or drink and then returning. Sheets of black plastic were placed in between the nest and the public area to give the male some privacy. As is typical of tinamous, he remained motionless on the nest and was extremely tolerant of keepers' approach. Animal care staff could approach very closely and even touch the incubating male without causing him to leave the nest. Incubating tinamou males have been known to feign injury and perform dramatic distraction displays when frightened off the nest, however this behavior was never observed in this male. Six more eggs were laid over a period of 21 days, and upon candling all but two were found to be fertile. The infertile eggs were discarded and the four fertile ones were replaced on the nest, including one with a small crack.

To minimize the effects of hand-rearing, staff decided on paternal incubation despite the risks of chick mortality. The male appeared to be incubating very well which was promising.

The female laid two more eggs, 17 and 28 days after the first, and with six eggs now in the small nest it was starting to run out of room. By late October, the eggs were approaching the estimated hatch date so staff began preparations for the chicks. The female was moved to the exhibit next door, and more black plastic was placed in between the two exhibits so that the male would not be distracted by seeing the female in close proximity. The small pool was dropped and replaced with shallow water pans lined with small rocks. The small plastic rock containers that conceal mousetraps were also removed from this exhibit as well as the adjoining exhibit. On 2 September the remaining animals were removed from the exhibit leaving only the incubating male and the 1.1 Fairy bluebirds

that were not considered a threat to the hatching chicks. Keepers and Commissary made plans to provide the chicks with ratite starter pellets and finely chopped greens, while discontinuing live insects in that exhibit and the adjoining one until the chicks were larger. Three eggs had pipped by the end of the day on 30 October, and four chicks hatched on 31 October including the cracked egg. The remaining two eggs were determined to be late-term deaths. Initially the male spent most of the day hiding the chicks under his body and wings; the chicks made a few forays into the exhibit without straying too far from the male.



This young Elegant Crested Tinamou is four days old. (Photo: Meghan Murphy, Smithsonian's National Zoo)

The four chicks were seen eating and drinking from their pans within two days of hatching. Newly-hatched chicks are capable of feeding themselves, however it is common

for the male to find food or insects and place it near the chicks for the first few days. The group was given three separate feedings (0800, 1130, and 1430 hrs) with the food divided between two shallow pans. If a paternal fecal was found, it was scooped and placed into the chicks' dishes to promote natural ingestion. Cleaning in the exhibit was kept at a minimum for the first week, with no hosing and minimal disturbances. Access was restricted to necessary personnel only to avoid any accidents. The four chicks appeared healthy and continued to develop normally. After a week the birds began to receive wax worms (*Galleria mellonella*) and were spending more time away from the male. After two weeks regular exhibit maintenance was resumed. The pool (approximately 6-8" deep/15.3-20.5cm) was refilled and rodent control resumed. The male began to spend more time away from the chicks and show some mild aggression towards keepers: pecking at shoes or pants legs, following them around the exhibit, etc. but this behavior had been normal for this animal before

the eggs were laid. Tinamou chicks are capable of flying short distances at one to three weeks old, however this behavior was not observed.

By 12 December the chicks had grown considerably and were now receiving two feedings daily (0800hrs and 1430hrs). The Ringed teal and Blue-winged teal were returned to the exhibit and the visual barrier separating the sire from the dam was partially removed. The ducks and the tinamous were not observed interacting but did remain on separate sides of the enclosure. As of 26 December, all four chicks are doing well and are being transitioned to ratite pellets in one pan that is fed in the morning and remains throughout the day. The chicks are similar in size to the adults but not as filled out in body weight. Some species of tinamou can achieve adult size within 20 days; however achieving adult weight can take between 85 to 108 days in Elegant crested tinamou. The female is still separated from the male and four chicks, and will most likely remain so until the chicks are moved to another exhibit or another zoo.

Bird House staff is fortunate to have achieved 100% chick survival rate in our parent-reared tinamou. We attribute our success to providing the sire with privacy and distraction from exhibit mates, visual distraction from the dam, and a bit of luck! We've all learned a lot watching these tinamou grow up, and hopefully any future attempts will go just as smoothly.

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## Acknowledgements

Thanks to Sara Hallager, Biologist at Smithsonian's National Zoo.

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# Ratite Behavioral Husbandry at the Philadelphia Zoo

By Wendy Lenhart, Bird Keeper and Ellen Bartuska, Mammal Keeper  
The Philadelphia Zoo, Philadelphia, PA

Ratites can pose a challenge to animal care professionals due to their large size. While these animals can be restrained and sedated for routine veterinary procedures, voluntary cooperation for these husbandry practices has enduring health benefits. Building positive relationships with collection animals allows short or long-term medications to be administered with high success rates and desensitizes the birds to keeper presence so that necessary exhibit maintenance does not induce stress. At the Philadelphia Zoo, keepers have used training for the husbandry of an elderly female Emu (*Dromaius novaehollandiae*) and a pair of female Ostrich (*Struthio camelus*) with great success.

In the winter of 2007, a 23-year-old female emu, "Mrs. Emu" at the Philadelphia Zoo exhibited a limp that was causing her to stumble and get abrasions on her left foot. Staff suspected arthritis was causing the discomfort and anti-inflammatory medication was prescribed. The Emu quickly began hand-feeding favored food items like apple chunks and ratite pellets from a bowl held by the keeper. Medication was successfully disguised in this food and delivered to the bird in this manner. Additionally, keepers were able to take advantage of their good relationship with the bird to administer a warm compress to the irritated area on her left leg. Once weather conditions warmed in the spring, keepers started targeting her to approach from across the yard for shifting purposes. The cue was a vocal "come here" and she was rewarded by grabbing an apple chunk from the keeper's flattened hand. After each training session, Mrs. Emu was given the bulk of her ratite pellets as a "jackpot" reward. Often this was given when she needed to shift indoors overnight.

Though the Emu was being treated successfully with oral medication for her arthritis, keeper staff and veterinary staff wanted to x-ray the affected area of her leg. Because of her large size and advanced age, it was not feasible to move the bird to the animal hospital for the procedure. The



"Mrs. Emu" stations for a voluntary x-ray  
(Photo by Amy Ivins)

plan was instead to train the bird to walk up a ramp to elevate her feet off the ground and snap images with a portable x-ray machine. The ramp used was 36"x 36"x 8" [.914m x .914m x .20m] with a 45° incline. The bird was desensitized to the ramp by first placing her food bowl on it as though it was a feeding station. Eventually keepers baited her to walk up it until she would wait at the top before receiving a food reward. Her food reward was modified to an entire bowl of ratite pellets and chunks of apple to keep her distracted during the entire procedure. This training took several weeks to complete and was embedded into her daily routine. Additionally, training sessions were done with the keeper wearing an

x-ray apron and holding an x-ray plate to desensitize the animal to these objects. The x-ray plate was fastened to a broom handle so that it could be positioned from a safe distance (see photo).

The first attempt to do the voluntary x-ray procedure with veterinary staff was only partially

successful because the bird became nervous and wary of the x-ray machine and the length of time it was taking for set-up. However, she did step in place as trained and tolerated the addition of two extra people in the yard prior to the introduction of the machine. The following day the process was greatly sped up and x-ray pictures confirming arthritis in the left leg were taken. The now 25-year-old Emu is still on anti-inflammatory medication and is still hand-fed, though she has been retired from her ramp-climbing. She is active and has a good quality-of-life due to the successful management of her condition.

During the summer of 2008, the Philadelphia Zoo added two young adult female Ostriches to the collection. They were estimated to be approximately three-years-old and had come from a large farm herd. After some initial challenges with administering their de-wormer in quarantine, animal department staff determined that a basic training program instituting target-feeding was in their best interest. Keepers did not encounter much initial aggression from these birds, but rather apprehension. To encourage bonding with their keepers, a program of hand-feeding was instituted. The birds had never been weighed, so scale training was an additional identified goal. It became apparent that a 1:1 bird to trainer ratio would be ideal. This posed some staffing challenges so a keeper from a different animal building assisted in the twice daily training sessions. In this case, mammal department keepers in the "African Plains" area at the zoo were responsible for the primary care of the Ostriches, but the Emu keeper from the bird department provided additional training support.

The Ostriches "Ethyl" and "Lucy" were each assigned a specific trainer who hand-fed ratite pellets from an individually colored three-quart feeder scoop purchased from a Nasco® agricultural supply catalogue. At the onset of training, the majority of the birds' pellets were offered during two daily training sessions. Whatever diet was left unconsumed at the end of the day was given *ad lib* overnight. The scoops were large enough to protect each trainer from a wayward beak and were conspicuous to the birds. These



"Lucy" targets to her blue ball for a pellet reward

(Photo by Marianne Lubenow)

interactions began at a fence dividing the animals from the people, but progressed to a point of open contact in the yard. Within a week, each ostrich would approach "their" keeper with "their" colored scoop with little to no hesitation and the animals could be easily shifted. It is important to note that some training foods were offered to these birds initially including apples, grapes, and pinky mice, but the birds were only interested in Mazuri® ratite pellets.

After the success with hand-feeding and baiting the animals across the yard, target sticks were introduced. These were made with 1/2" x 24" [1.27cm x ~61cm] wooden dowels with a three-inch [7.62cm] diameter plastic ball affixed at one end. As with the scoops, each bird was assigned a colored target. Keepers would present the target to their Ostrich while holding the feeder scoop behind their back with the opposite hand (see photo). Once Ethyl or Lucy pecked their ball, the scoop was brought out for a mouthful of pellet reward. Target stick retreated to behind each trainer's back until the next cue to move was to be given. It was important that the plastic balls were secure on the dowels because the birds became quite zealous with the process. They learned the targeting behavior within a few days and enthusiastically approached keepers at the beginning of each training session. It was also noted that before the initiation of training, the ostriches would leave some of their pellet diet at the end of the day, or lose a proportion of it to wild birds. By the time the targeting

behaviors were cemented, the majority of the pellets were consumed by the pair during training sessions reducing waste and allowing for better monitoring of food consumption.

Target training the Ostrich pair gave the flexibility needed for positioning the birds for their first voluntary weights. An Arlyn® 320-Vet scale was placed between two hoofstock stalls adjacent to the indoor ostrich holding. The stall door separating the two stalls was closed just enough to allow passage of a single bird. Keepers worked the birds from one stall to the other through the narrow gap and eventually placed the scale in the gap so that the birds had to pass over it. Both birds were initially nervous with the new surface and would place a single foot on it or not remain still long enough for the weight to register. After another several days of steady repetition, nervousness abated and weights were finally recorded for both birds.

The intensity of the early training has since diminished but the pair still reliably hand-feeds, shifts, and takes oral medication when needed. There is also reason to believe that Ethyl and Lucy were able to discern the difference in color between their feeder scoops and targets. On several occasions after the major training milestones had been reached, keepers switched birds, and used the individual bird's same colored targets and scoop to rule out trainer bias. On another occasion, the birds were separated from each other, and one trainer offered two different colored target choices to each bird. One ball was the color to which the bird was originally trained and the second was the color to which the alternate bird was trained. With a very high success rate, the birds were able to discern and target to their "correct" colored ball. Keepers hope to run some color-choice trials in the near future for further research.

Interdepartmental cooperation played an immense role in the success of the ratite training that has taken place at the Philadelphia Zoo. Open dialogue between keeper, curatorial, nutrition, and veterinary staff was invaluable when assessing animal needs and making important training steps. A special thanks goes out to Paul Kalka, primary relief and secondary trainer to "Mrs Emu" as well as veterinary staff Dr. Chris Montgomery, Dr. Donna Ialeggio, Dr. Keith Hinshaw, Martha Vaca and Sue Isackson. Thanks also to Dr. Aliza Baltz, Christine Bartos, Kim Lengel, Betsy Karkowski, and Lynn Tummer.

Notes:

Ratite Training Goals for Behavioral Husbandry at the Philadelphia Zoo

Emu Training Goals

1. Reliably get the emu to hand-feed to establish/reinforce a positive relationship and voluntarily deliver medication
2. Target the emu to approach the keeper on cue to facilitate shifting
3. Desensitize the emu to touch to apply warm compresses or other necessary topical medications
4. Train the emu to station for a voluntary x-ray using a portable x-ray machine in her outdoor yard

Ostrich Training Goals

1. Reliably get the ostriches to hand-feed to establish/reinforce a positive relationship and voluntarily deliver routine medication
2. Target train the ostriches to approach keeper staff on cue to facilitate shifting
3. Fine-tune target training to position the ostriches on a scale for voluntary weighing

**Author's Addendum:** "Mrs. Emu" died on 25 January 2010, less than a month short of her 26th birthday. She was an intelligent and gentle animal who will be sorely missed by those who had the opportunity to work with her.

# Frogmouth Management at SeaWorld Orlando and Discovery Cove

By Liane Berlepsch, Senior 1 Aviculturist  
SeaWorld Orlando, Orlando, Florida

## Introduction

Tawny frogmouths (*Podargus strigoides*) belong to the order Caprimulgiformes. They are often mistaken for owls because of their similar appearance. They resemble owls with their large eyes and body shape and are nocturnal and silent in flight. Unlike owls that hunt with their talons, Tawny frogmouths hunt with their mouths. Prey is either caught on the ground or they sit and wait for prey to come to them, using the feathery vibrissae around their bills to direct insects into their mouths. Frogmouths are native to Australia, coastal islands and Tasmania. They are found in heavy forests, but are also common in suburban areas. Being nocturnal and solitary, they are rarely seen.

The breeding of frogmouths at SeaWorld Orlando has always been encouraged and there was a burst of reproduction in 2000 from a very prolific pair. Today, we have five pairs set-up for breeding and in the past 24 months have had chicks or eggs from all five. Care, exhibit set-up and hand-rearing of the chicks has involved the entire Aviculture staff from both SeaWorld and Discovery Cove.

Since 2000, the North American population of Tawny frogmouths has declined by 29%. Over the last decade (1999-2009), 54 frogmouth hatchings have occurred and 22 of those hatches (41%) occurred at SeaWorld Orlando. An overall 35% chick mortality (death at <30 days of age) has been observed during this ten-year period. By employing and refining hand-rearing techniques for the species, SeaWorld Orlando has increased the survival (<30-day) rate of chicks by 12%. The current intense program will continue until the North American population becomes stable. At that time, breeding pairs may be relocated to other institutions to free up space for additional species. The long-term sustainability of captive bird populations has been the subject of much discussion over the last five years. A steady and sustained decline in the North American Tawny frogmouth population, coupled with a low reproductive rate, prompted the Population Management Program (PPM<sup>®</sup>) to identify captive-breeding as the program's top priority. SeaWorld Orlando recognized this goal and devoted important off-exhibit space to work with multiple breeding pairs. Genetically important frogmouths, which were otherwise being utilized for Education/Presentation purposes within the SeaWorld organization, were re-allocated for breeding purposes and other frogmouths identified through the PMP<sup>®</sup> were brought into the collection in 2007 (Myers, 2009).

## Enclosure

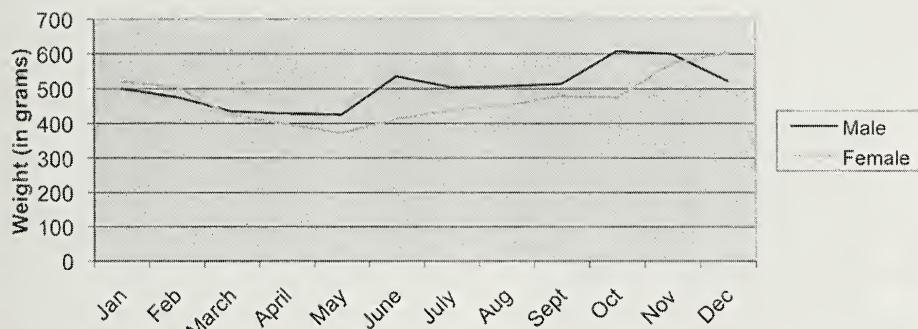
Tawny frogmouths in our collection have been housed in a variety of habitats. Due to their docile nature, they can be exhibited with almost any other species of bird. They have thrived in free-flight aviaries, large walk-through exhibits and smaller aviaries on- and off-display. In the past, we have seen successful breeding by certain pairs regardless of where they were housed. However, with the recent commitment to breed frogmouths, every attempt has been made to isolate pairs in their own aviaries that offer the least amount of distraction. These off-exhibit areas are fairly simple, wire-framed aviaries of different sizes with substrates of concrete or mulch. Foliage ranges from a single potted palm to a fully planted aviary. All are outdoors and offer an ample amount of flying room. Aviaries are perched in such a way that natural light can reach the birds, as frogmouths love to sun themselves. Perches don't need to be plentiful, but varied in height. Some birds like to perch as high as the rafters; others prefer to be at lower levels.

## Diet

Historically, frogmouth diets have been offered by hand rather than from a food pan. In the past,

the birds were fed twice a day with staff going out of their way, even climbing trees, attempting to feed them. With experience came the realization that frogmouths do well on one feeding a day and our procedure changed to hand-feeding only in the mornings, until the birds were satiated. It is not uncommon for some birds to refuse food for days and still thrive. Mice, typically peach fuzzy and hopper sizes, bugs, including frozen crickets (thawed out) and mighty mealworms, were given as part of their daily diet. Most birds have their preferences on the size rodent they will accept; some will even refuse the larger mice, preferring only the smaller sizes. Some Tawny frogmouths can be enthusiastic feeders, making it almost impossible to hand feed bugs. They snap at the food items and sometimes get a finger instead. These birds can be fed using large tongs to prevent this. Even without the bugs, the rodent diet, sprinkled with calcium carbonate and Vionate® in a 50:50 ratio, is sufficient. For enrichment, Tawnys will hunt live crickets offered by the aviculturists. Appetites fluctuate often, even daily. Some birds may be hunting at night in their aviaries without us knowing, which would explain their appetite flux. However, it is important to be familiar with the birds' eating habits. Where it may not be unusual to go off food for some individuals, it could be concerning for others. Keep in mind it is not uncommon for adults to refuse eating at times, especially when they are handled or moved to a new area. Along the same lines, weights will also fluctuate throughout the year.

### Adult Male/Female Average Weight Comparison



Because our frogmouths were hand feeders, they were never given the opportunity to raise their own offspring. This year a plan of action was put into place to modify their eating habits and condition them to eat from a pan. We wanted them to be self-sufficient and no longer rely on the aviculturists as their source of food. Before the process was implemented, all birds were weighed and then monitored closely during the transition period. Hand-feeding was eliminated right away. The birds are most active in the early morning before the sun comes up, and diets were offered at this time. Food items were placed in a shallow pan and held in front of the birds so they could help themselves. Using live mealworms stimulated them to lunge for the food, so a healthy amount was placed into the bowl. About 15-25 worms were given, depending on the skill and interest level of each bird. The birds that caught on quickest got fewer worms than those who were slower to figure it out. Peach fuzzies were also in the shallow pan and often appeared to be picked up accidentally, as they would get covered by the worms. Any leftovers were placed in a ceramic crock with more meal worms added, then placed below the perch so they could see the movement of the worms.

Once the birds caught on to picking up food on their own from the crock, the crock was then placed directly into a stand. Crickets were initially included as they were items hand-fed; however, they were never eaten. Although some birds took longer than others to figure it out, the transition only took a couple of weeks. Their diet is now placed in a ceramic crock (as plastic feeders get flipped over). The crock is placed in a larger, rectangular stainless steel pan lined with a mat so the birds don't slip when landing. This pan is on a stand raised off the ground. It is important to leave a clear flight path to the food stand. The diet is offered in the evening, left overnight and picked up in the morning. The remaining food items are recorded. Presently, the diet per bird is one hopper, six peach fuzzies and mealworms. The amount of rodents for each diet varies. Not only do individuals have

different appetites, but throughout the year appetites fluctuate. Amounts are adjusted as is deemed necessary. Today all of our Tawny frogmouths pan feed. With this new feeding protocol in place, we hope to give the birds a chance to raise their own offspring.

### Introducing Pairs

Introducing Tawny frogmouths is much less dramatic than many other species. Initially birds are placed side-by-side in howdy cages. We used hanging cages, measuring 4ft.x4ft.x4ft. [1.2m x 1.2m x 1.2m] suspended from the ceiling. The next step is placing them in a cage together with limited perches so they are encouraged to be near each other. Sitting side by side is usually the first indication of pair bonding. One pair was introduced by this method and after two months of perching on opposite sides of the enclosure, it was decided they were an incompatible pair. There was also one opportunity to house the male

with two females. This worked to the male's advantage as he did choose one female for his mate. If using this method, monitor the birds closely and remove the extra female once the male makes his choice to avoid aggression. Even with our successes, because they are nocturnal, frogmouth breeding is still somewhat mysterious to us. A pair is put together, a nest given and eggs are found. No courtship is seen and no bonding behaviors are observed. Occasionally the birds will be witnessed adding nesting material to their nest site. The only indication we've seen that a pair has perhaps bonded prior to egg laying is perching in close proximity to each other and vocalizing back and forth. Both sexes vocalize, but the females are often more vocal than the males. They are most vocal in the early morning, evening, and before breeding season. Birds seem to be quite vocal if they are within sight of any other Tawny frogmouths.



**Feeding Stand**

*(Photo by Liane Berlepsch)*

### Nesting

Nests given are constructed with a grapevine wreath cable tied to a shade cloth bottom, just large enough for them to fit in, about the size of a salad plate. The nests are secured to perches or in areas that the birds seem to occupy frequently. Multiple nest sites are offered, as they may be



**Nest Constructed by Birds**

*(Photo by Liane Berlepsch)*



**Grapevine Nest**

*(Photo by Liane Berlepsch)*

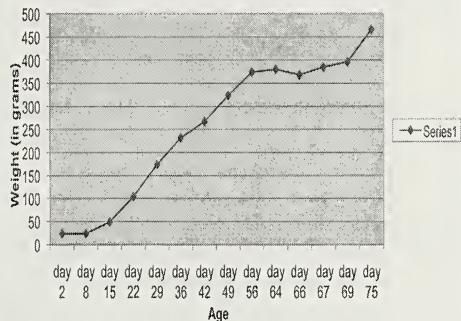
particular about where they decide to nest. Pairs have also utilized upright palm logs that were in the exhibit as décor. Both tall and short logs, with either a slight depression or a rotted-out interior, have been chosen and occupied as nests. The amount of nesting material used seems dependent on the individual. One aviary had only one potted palm plant and broken and stripped leaves were found in the nest. It is unknown whether the female builds, but males definitely do. One male, who was

unpaired, chose an empty hollow palm log as his perch of choice. One spring he made it into a nest, filling it with twigs and leaves, and occupied it comfortably until we dislodged it. With one pair, the male dominated the nest site, often sitting on it days prior to eggs actually being laid. It was even unknown if the female did any incubating, as the male was on the nest when we left at night and upon arrival in the morning. However, with one of the newer pairs, both male and female were seen randomly on the nest and after eggs were laid, both were seen on the nest incubating.

### Incubation and Hand-rearing

Tawny frogmouths have laid eggs from December to May. They usually lay two eggs per clutch and some will re-clutch if given the opportunity. With inexperienced birds there is often hesitation leaving valuable eggs with them. Eggs are pulled from the nest and placed into an incubator and a dummy egg is left for the birds to tend to. The artificial incubation parameters for the Orlando climate are 99.5°F [37.5°C] for the dry bulb and 44-48% relative humidity. If a pair proved to be diligent in incubating the dummy eggs, their real eggs were given back to them, and any future eggs left with them. They will only be put in an incubator if absolutely necessary; for example, abandonment of an egg, or a pair that consistently breaks eggs. Because the birds have yet to raise chicks, the eggs are left in the nest until Day 25 (first egg) and then pulled and placed into an incubator until hatching. This is three days prior to that egg's predicted hatch date. Once externally pipped and placed into a hatching bowl or tray, hatching may take 36-48 hours. All incubator-hatched chicks are set up in a brooder to be hand-raised by an aviculturist. The chick is placed in a small bowl appropriate for its size, lined with a paper towel so the consistency of the feces can be easily monitored. (We use Wypall\* brand® towels). The size of the bowl will grow with the chick. Temperature of the brooder is started at 96°F [35.5°C]. A specimen cup, with holes punched in the lid, filled with a wet sponge maintains the humidity. If the chick needs a higher humidity, a warmed, damp towel can be placed in the brooder. It is important to keep the temperature and humidity high until the chick's first defecation. A Tawny chick may not defecate for three days, which is not unusual. Stimulation may be necessary at this point, but not beforehand. Brooder temperature should be dropped as necessary, as the chick grows feathers. Allow the chick's comfort level to determine the temperature.

Tawny Frogmouth chick



Tawny Frogmouth Chick

(Photo by Sharon Jarvis)

The first feeding is given 12 hours after hatching. Some chicks will give strong feeding responses right away, while others may need to be stimulated with a tap on the side of their bill. Tweezers are used to feed the chicks, as initial food items are rather small. The chick is fed pinkie viscera initially, graduating up to cut pinkies, and eventually whole pinkies as the chick ages. The chick is fed until satiated. However, the first day, or until it defecates, we are more conservative with the amounts. The first two days soak the viscera in warm lactated Ringers injection, USP®, and then just warm water from that point on. Calcium carbonate and Vionate® at a 50:50 ratio, are sprinkled on food items at every feeding. Chicks need to be fed with a heat source, as they chill quickly when out of the brooder. Heat lamps may cause retinal damage in a nocturnal bird, thus a heating pad or ceramic bulb is preferred. To measure the small amounts fed, obtain the weights of the chick before and after feeding. Chicks are fed five times per day, three and a half to four hours apart. At approximately two weeks of age, or as a chick loses interest in one or more feedings, the feedings will drop to four per day. Again, at about three weeks of age, the chick should be down to three feedings per day and comfortable at room temperature.

and a half to four hours apart. At approximately two weeks of age, or as a chick loses interest in one or more feedings, the feedings will drop to four per day. Again, at about three weeks of age, the chick should be down to three feedings per day and comfortable at room temperature.

Aside from temperature, humidity and feedings, it is important to pay attention to the chicks' legs. The bowl bottom should be lined with a substrate, such as Enkamat®, to give the chicks' feet something to grip on to. This needs to be implemented no later than one week, as splaying of legs has occurred. One peculiarity that appears in some frogmouth chicks is a milky coloration to their eyes. This is normal and should not be a cause for concern. By necessity we have become proficient at hand-rearing, however, the ultimate goal is to be hands-off, allowing the parents the opportunity to care for their young. Now that all the frogmouths are self-feeding, there is hope that future chicks will be parent-reared. Close monitoring of the chicks will take place and they will be pulled for hand-rearing or supplemented, if necessary. However, the breeding pairs are very attentive to their eggs, so we are hopeful that they will be successful in rearing their own young.

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AZA Avian Scientific Advisory Group.

**Data from four chicks from 2007-08 ages 1 to 15 days.**

Age	Average weight of chicks(g)	Average amount fed per day
1	15	0.73*
2	15	1.13
3	20	1.15
4	22	1.49
5	24	1.64
6	27	2.2
7	32	1.8**
8	39	8-Feb
9	48	9-Apr
10	58	6-Feb
11	66	11-Jan
12	81	8-Apr
13	90	10-Mar
14	100	10-Apr
15	114	10-Mar

\*grams of pinkie viscera

\*\*at this point pinkies can be fed with heads, tails, feet cut off and into thirds or halves, depending on the size of the pinkie and chick. These numbers are how many pinkies are used and ranged of how many are fed at each feeding.

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# **Incubation and Hand-rearing of a Greater Rhea (*Rhea americana*) at the Great Plains Zoo**

By Cassandra Sampson, Area Supervisor and Hans Jorgensen, Zookeeper  
Great Plains Zoo, Sioux Falls, SD

## **Introduction**

The Great Plains Zoo is a 45-acre zoological facility in Sioux Falls, SD that houses over 150 species of animals. Among the zoo's 52 species of birds, three ratite species are represented, including Ostrich (*Struthio camelus*), Emu (*Dromaius novaehollandiae*), and Greater Rhea (*Rhea Americana*).

The Greater rhea is one of five species of flightless birds known as ratites. Native to the pampas and sparse woodlands of eastern South America, these birds are considered nearly threatened by the IUCN. Rheas are relatively common in their home range, but their numbers appear to be declining in the wild. According to ISIS (International Species Information System) data, there are currently 273 Greater rhea being held in North American ISIS institutions, with only 15 birds being hatched out in 2008.

The Great Plains Zoo has had a group of rheas on display since 2003. The original group of birds was all related; therefore any eggs laid were discarded. In 2008, after shipping out one of our males and losing our second to old age, the decision was made to increase our flock size and breeding potential by hatching out eggs brought in from another facility.

Like other ratites, the males of the species are the ones to incubate the eggs and care for the chicks after hatching. Since our current group was comprised of only females, any chicks we hatched out would have to be hand-reared.

After searching for institutions that were breeding rheas to check into the availability of eggs, it became apparent that the population of rheas in zoological facilities in the United States had been aging in the last decade and that few birds were being added to the population.

In April of 2008, we received three different shipments of eggs, for a total of seven, from Lion Country Safari in West Palm Beach, FL. The eggs were shipped via overnight mail by the United States Postal Service in foam laden containers in an attempt to limit unnecessary shifting during shipment.

## **Incubation**

Upon arrival, the eggs were placed in our Humidaire® incubator. Each egg was weighed daily and candled occasionally to check for viability. Six of the seven eggs were eventually pulled from the incubator and discarded based on candling observations. The remaining egg hatched. It was laid on 12 April 2008 and was placed in our incubator on 15 April. The incubator was set to 79°F [26.1°C] on the wet bulb with 45% relative humidity to achieve a 15% weight loss through incubation. The incubation period for Greater rheas is 36-40 days. Our chick hatched out on 20 May, after 36 days of incubation. The egg actually lost 18% of its weight over the course of incubation.

## **Hand-rearing**

The chick was kept in our veterinary facility in a small stainless steel cage with supplemental heat to begin with, and was moved to a larger pen in the same building when size necessitated it. Impaction can be a major concern with young ratites, as they are inclined to eat any small object that they see. Keeping our chick inside allowed us to control the temperature, as well as the substrate, thus eliminating impaction concerns.



**Greater Rhea Chick**  
*(Photo provided by the authors)*

The food we decided to offer the chick was Mazuri® brand Ratite Starter, but had trouble receiving it in time, so we had to start with a less than ideal waterfowl starter. With parent-reared chicks, you usually worry about giving too much food right away, because of impaction concerns, but with our lone chick, getting it to eat was the challenge, so no food restrictions were put in place. We housed the chick on newspaper, and scattered the food on the paper so that when it walked around, the food would "jump", as well as offering a dish of food. We also tried sprinkling chopped greens in the food and water, and offering mealworms. A chicken was also placed in its pen for awhile in the hopes that it would show the chick how to eat, but to no avail. Several times a day, we would take the chick out, put it on the floor, and try to show it how to eat by pecking at food scattered on the floor with our finger or shaking the food on a piece of newspaper. This seemed to be the most successful way of getting our chick to eat in the first two weeks. It wasn't until we received the ratite starter on Day 14

that it really started to eat well on its own. We weighed the chick daily, and after Day 15 its weight consistently increased (See Table 1 and Figure 1). We started adding granite grit to the diet on Day 8 at 3% by weight to condition the ventriculus for forage.

It was very clear that the chick was imprinted on people and did not like being left alone in the cage. It would vocalize almost constantly when left alone. By June, the chick was trying to get out of its cage, and a towel had to be hung on the cage door to stop it from rubbing its beak. Unfortunately, an abrasion on its beak did develop, but applying Vetropolyclin ointment cleared it up.

We started taking it outside for walks in the grass on 6 June. It would follow the keeper outside and eat grass. We wanted to gradually introduce forage into its diet. By 13 June, we decided to make a temporary outdoor pen that the chick could spend a few hours a day in if the weather was nice. We constructed a small make-shift pen approximately 4'x4'x4' [1.21mx 1.21m x 1.21m] out of chicken wire wrapped around T-posts and placed it under a willow tree on a grassy lawn just outside our veterinary facility. Being outside gave it the opportunity to get natural sunlight as well as eat grass. It eventually started rubbing its beak against the chicken wire trying to get out, so we hung sheets on the inside of the chicken wire to eliminate the rubbing.

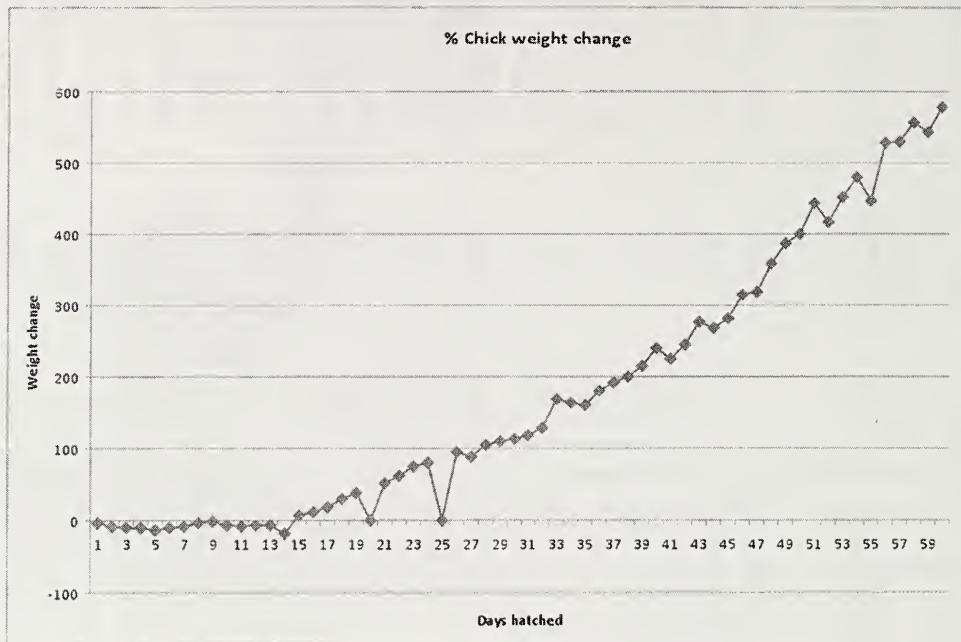
Also in June we sent a blood sample to the Brookfield Zoo for sex determination. The test showed that we had a female chick. Since we really needed a male to form a breeding group, we decided to bring in 2.3 young parent-raised rheas from Omaha's Henry Doorly Zoo. Upon their arrival in August, our chick was introduced to the group in quarantine. All six chicks were around two months old at this time, and were switched from Mazuri® Ratite Starter to Mazuri® Ratite Maintenance.

In September, the young birds were introduced to our three adult females on exhibit. Our hand-reared chick did tend to stay off by herself for the first couple of months, and every time we entered the exhibit she would come right over, but in time she started to associate herself more and more with the other birds.

Table 1:

Age (in days)	Chick weight (grams)	% Weight change	Age (in days)	Chick weight (grams)	% Weight change	Age (in days)	Chick weight (grams)	% Weight change
May 20-hatch date	308	0						
1	298	-3.246753247	21	468	51.94805195	41	1000	224.6753247
2	284	-7.792207792	22	498	61.68831169	42	1064	245.454555
3	275	-10.71428571	23	538	74.67532468	43	1158	275.974026
4	278	-9.74025974	24	554	79.87012987	44	1134	268.1818182
5	268	-12.98701299	25	No data available		45	1176	281.8181818
6	276	-10.38961039	26	600	94.80519481	46	1280	315.5844156
7	282	-8.441558442	27	582	88.96103896	47	1290	318.8311688
8	299	-2.922077922	28	633	105.5194805	48	1412	358.4415584
9	304	-1.298701299	29	648	110.3896104	49	1500	387.012987
10	289	-6.168831169	30	658	113.6363636	50	1542	400.6493506
11	284	-7.792207792	31	670	117.5324675	51	1672	442.8571429
12	290	-5.844155844	32	704	128.5714286	52	1590	416.2337662
13	286	-7.142857143	33	826	168.1818182	53	1700	451.9480519
14	252	-18.18181818	34	812	163.6363636	54	1785	479.5454545
15	328	6.493506494	35	802	160.3896104	55	1684	446.7532468
16	344	11.68831169	36	860	179.2207792	56	1936	528.5714286
17	363	17.85714286	37	898	191.5584416	57	1938	529.2207792
18	399	29.545454555	38	926	200.6493506	58	2020	555.8441558
19	424	37.66233766	39	970	214.9350649	59	1980	542.8571429
20	No data available		40	1048	240.2597403	60	2088	577.9220779

**Figure 1:**



Note: No data available for days 20 and 25

## Conclusion

Hand-rearing of our Greater rhea proved to be a fun learning experience, with a few challenges along the way. Getting the chick to start eating was our biggest challenge, and a lot of time was invested in showing it how to eat in the first two weeks. Other challenges were faced with a little creativity, such as hanging sheets on the caging to eliminate the chick's desire to get out. It was very rewarding to see our chick from hatching all the way to integration into a group of conspecifics. Our experience helped us to develop a road map for future hand-rearing of ratites.

## Acknowledgements

We would like to thank the Ratite TAG Chair, Sara Hallager, from the National Zoo for her guidance and willingness to share information, as well as the staff of Lion Country Safari for taking the time to collect and ship the eggs. The entire staff of the Great Plains Zoo also deserves credit for their involvement in the successful hand-rearing of our chick.

# First Time Breeding of Captive Sulawesi Knobbed Hornbills (*Aceros cassidix*) at St. Augustine Alligator Farm Zoological Park

By Stephanie Krueger, Senior Bird and Mammal Keeper  
St. Augustine Alligator Farm Zoological Park, St. Augustine, FL

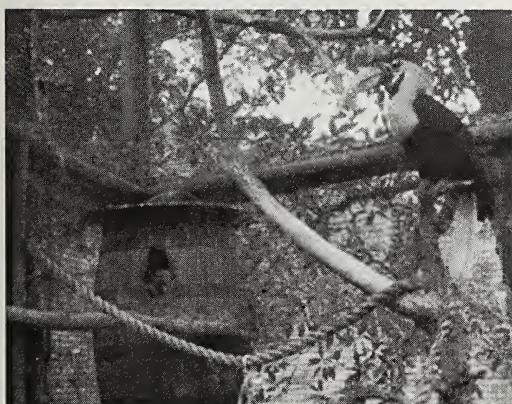
The St. Augustine Alligator Farm Zoological Park acquired a female Sulawesi knobbed hornbill (*Aceros cassidix*) in late 2008, and after successfully introducing her to the resident male, the park began setting up an on-exhibit breeding situation for the 2009 season. Several steps were taken to encourage breeding, including: research of species courtship and breeding requirements, diet alternations to condition the birds for breeding, and supplying an adequate cavity nest.

Because this species had never been bred at the zoo before, additional information was gathered about how and when these birds breed. Wild Knobbed hornbills had been observed breeding during the mid to late summer in their native range of Sulawesi (Kinnarird, 1999, p.61), but the Florida climate of St. Augustine meant that similar weather conditions of temperature and rain occurred earlier in the year, around February or March. So as to not miss the ideal breeding time, it was decided to set up the birds at the very beginning of 2009.

Courtship behavior and nesting requirements were the next two objectives explored. Using behavioral observation data provided by EAZA Hornbill Management and Husbandry Guidelines, staff was able to conduct casual observation of the pair (Galama, W., King, C., Brouwer, K., 2002, pgs. 59-61). The observed behaviors included allo-preening, allo-feeding, quiet vocalizations to one another, and “shoving” or “pushing” of the male by the female when perched side by side. These behaviors were observed immediately upon introductions, and suggested that the birds had bonded and would attempt to breed.

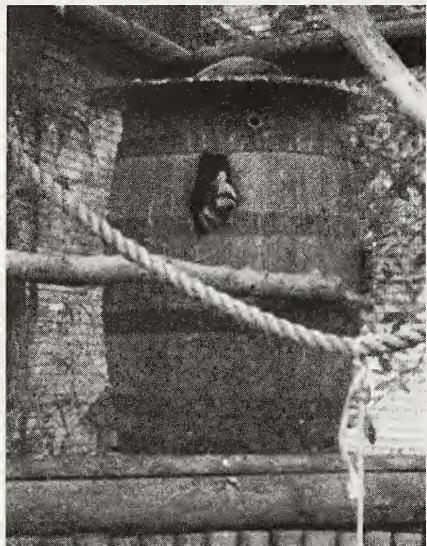


Nest Hole - Mudding behavior was observed by both the male and the female hornbills  
(Photo by Gen Anderson)



The male, Kong, stands watch over the female, Fay, who is putting the last touches on the mudded nest entryway.  
(Photo by Gen Anderson)

Next, alterations were made to meet breeding requirements. Sulawesi knobbed hornbills, like other hornbills, are cavity nesters. Females will seal themselves into the selected cavity with mud, feces, and food. Only after the female is sealed in will she lay and incubate eggs, and will even spend several weeks after the eggs have hatched in the cavity feeding and caring for the chicks. During the females' seclusion, she is entirely dependent on the male for food, so a quality diet and a strong pair bond are required for breeding success. To prepare for this, hopper mice were added to the previous diet for additional protein and as a gift-giving opportunity for the male.



Mudding behavior was observed over several weeks. However, in a single week, the female secluded herself in the nest barrel and successfully muddled up the entry hole on her own. (Photo by Gen Anderson)

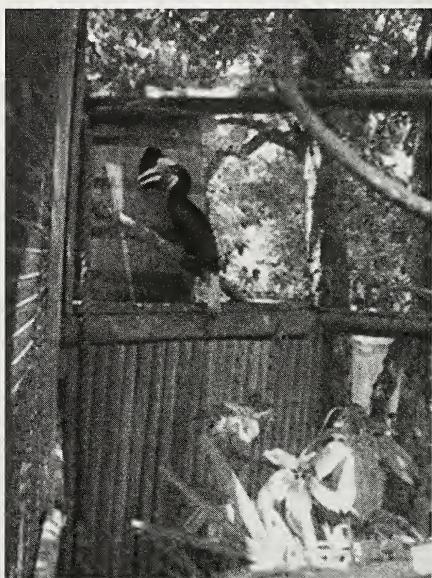
with a jigsaw 55cm up from the bottom of the barrel. The boards of the barrel were 2cm [.78in.] thick, so the edges of the opening were roughed up with a hand saw to help the hornbills apply sealing material. A small observation door measuring 20cm x 20cm [7.87in. x 7.87in.] was cut into the back of the barrel for keeper observation purposes. The barrel was filled 2/3 full with dry pine shavings and was installed on a ledge on-exhibit approximately 2.5m [8.2ft.] off the ground with a level plywood roof secured on top of the barrel to shelter it from the elements. Lastly, a perch was added next to the barrel's entrance to facilitate entry into the nest and feeding of the female by the male.

After the barrel was placed in the exhibit, funding was obtained for an infra-red camera which was mounted on the barrel roof, allowing staff an overhead view of the inside of the nest barrel available for viewing 24 hours a day. This camera was inexpensive (approximately \$100) and easily installed because it was added as an additional feed line on the pre-existing security camera network. This camera proved valuable as it allowed staff to monitor several aspects of the females' seclusion, including: the females' condition in the nest barrel, how much, how often, and of what variety the male was feeding the female, when an egg was laid, when the egg hatched, and the progress of the resulting chick. The frequency of feedings for the female was an initial concern because this was an inexperienced first-time pair. Also, there can never be too much

at the beginning of January 2009. Providing valuable food items for gift giving helps establish the necessary pair bond. Also, because of the nest sealing behavior of these birds, their diet was made stickier with the addition of ripe bananas and soaked softbill pellet. A small bowl of wet clay was also offered on exhibit for sealing purposes (Galama, W., King, C., Brouwer, K., 2002, p. 49).

The final step was the addition of a suitable nesting cavity. Several options suggested by the EAZA Hornbill Management and Husbandry Guidelines were explored, including cement cylinders, modified box style nest cavities, and barrels or wine casks. The final decision was to use a modified wine cask as the nesting cavity. Compared to the other options, the wine barrel was easier to modify, the appropriate size for the exhibit space, and readily available since a suitable cask was already on property. The barrel used was a wine barrel measuring 55cm [1.8ft.] in diameter and 86cm [2.8ft.] tall. An oblong entry hole, dimensions 25cm long by 14cm [9.8in. x 5.5in.] across, was cut into the barrel

The boards of the barrel were 2cm [.78in.] thick, so the edges of the opening were roughed up with a hand saw to help the hornbills apply sealing material. A small observation door measuring 20cm x 20cm [7.87in. x 7.87in.] was cut into the back of the barrel for keeper observation purposes. The barrel was filled 2/3 full with dry pine shavings and was installed on a ledge on-exhibit approximately 2.5m [8.2ft.] off the ground with a level plywood roof secured on top of the barrel to shelter it from the elements. Lastly, a perch was added next to the barrel's entrance to facilitate entry into the nest and feeding of the female by the male.



After several long months, the female emerges from the nest barrel, but frequently returns to check on the chick still inside. (Photo by Gen Anderson)

information gathered on the actions and success of a breeding pair of secretive birds.



Makassar - The first successfully bred Knobbed Hornbill at the St. Augustine Alligator Farm Zoological Park.

(Photo by Greg Lepera)

Overall this project was a success resulting in the hatch and fledge of a single Sulawesi knobbed hornbill chick. From this breeding experience, several observations can be made. First, the diet alterations seemed to increase bonding behavior between the birds, and the addition of sticky material stimulated sealing behavior in both the male and the female. For the barrel, the size of the cask, the nesting material within, and the location of the barrel were adequate. However, a more substantial and angled roof to better shelter the barrel from rain should be added, and a lower entry hole should be cut so the female and young chick have easier access to the male outside.

Lastly, the infra-red camera proved an invaluable tool for data collecting, but will also need some modifications. The camera was installed directly into the roof of the barrel and was sheltered by an arrangement of plywood and heavy rocks, and after the barrel was put on the exhibit the female became nervous when she visited the nest barrel and spent several weeks picking at the camera lens in the ceiling. Because of this, the camera became damaged towards the end of the season. A more substantial housing and installation prior

to the breeding season should allow the birds more time to adjust to its presence in the barrel and should solve this problem. Also, the camera was part of the security system and meant keepers only had limited access for viewing purposes. Hopefully, an additional or separate server may allow more "open" viewing access for keepers in the future.

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# Artificially Inseminating White-naped Cranes

By Chris Crowe, Bird Keeper

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## Introduction

With their loud bugling calls, stately gait, and tall posture cranes are among the most majestic birds in the world. They are also one of the most endangered bird families with 11 out of 15 crane species endangered worldwide. The primary threats to their survival are habitat loss, habitat degradation, and human disturbance as the wetlands they nest and feed in are altered or destroyed by humans. There are less than 5000 White-naped cranes (*Grus vipio*) left in the wilds of China, Mongolia, Russia, Japan, and North and South Korea. The endangered White-naped cranes cared for at the National Zoo's Conservation and Research Center (NZP-CRC) are part of an international captive breeding program managed under the auspices of a Species Survival Plan (SSP<sup>®</sup>) with the goal of maintaining a security population to save the species from extinction in the event that the wild population is extirpated. Breeding is managed to ensure that the population is demographically stable, genetically diverse, healthy, and self-sustaining. Occasionally behavioral or physical limitations prevent certain cranes from breeding naturally, requiring the use of artificial insemination (A.I.). At NZP-CRC we have come to specialize in using A.I. to produce offspring from cranes that are unable to breed naturally. This encompasses cranes other zoos were unable to breed, including the most genetically valuable White-naped cranes in the SSP<sup>®</sup>. Not only have we been able to produce chicks from these birds through A.I., but we were also able to train them to accept artificial insemination without physical restraint.

## Artificial Insemination

The technique of A.I. requires the handling and restraint of cranes for both semen collection from the male and artificial insemination of the female. Every effort is made to reduce the chance of injury and stress to both birds and their keepers during the A.I. procedure. The main way to reduce stress for a crane is to always conduct the A.I. training and eventual procedure in the same way with the same people. Training is conducted in exactly the same way as the eventual procedure so that once the cranes are responding properly the change to actual semen collection and A.I. will be as seamless as possible. The cranes will never enjoy being captured and restrained, but as they become familiar with the process their stress level will decrease. Their stress and risk of injury declines as they realize they will not be harmed and the efficiency and quality of the procedures increases once the birds know what to expect.

The A.I. technique we use involves manually massaging the male crane to stimulate him to produce the semen and soon afterwards manually massaging the female so she will accept artificial insemination. While the cranes are held against their will, they are gently stimulated to respond reproductively and cooperate with the procedure.



Abigail with Amanda's chick.

### *"Abigail" the White-naped Crane*

Abigail was hatched overseas and arrived at NZP-CRC in 1998 at the age of 16 having never produced any offspring. She had been paired with a male while at her previous institution but despite their strong bond, impressive nests, and faithful egg incubation, they never hatched any chicks. Soon after Abigail's arrival we noticed that she would occasionally favor her

hatched any chicks. Soon after Abigail's arrival we noticed that she would occasionally favor her

left leg. The medical records from her time at other institutions noted occasional left leg lameness all throughout her previous 16 years. We brought Abigail in for x-rays to diagnose her injury and develop possible treatment. The radiographs revealed both the cause of her limping and the reason she had never produced any chicks. Abigail's left femur was missing its femoral head which prevented the femur from articulating with the pelvic girdle. Her dislocated femur extended beyond the pelvis and towards her lower back. The proximal end of the femur could actually be felt protruding below the feathers, skin, and muscles on the crane's back. The obvious result was a decrease in muscle mass and range of motion for her left leg. This caused Abigail to limp periodically and prevented her from being able to support a male's weight during copulation. Given her long history of favoring her left leg, we suspected Abigail's condition was likely due to a traumatic injury that occurred when she was a chick and was somehow previously undetected. She somehow adapted to the injury and learned to function normally except for occasionally limping and being unable to breed naturally. At the time of the diagnosis, her long-term prognosis was poor. Over time her bouts of limping became less common and severe. Because of her physical limitations to breeding, Abigail became a prime candidate for A.I. Had we considered her condition to be genetic we would not have allowed her to breed. She was paired with an SSP® recommended male that was 10 years her junior and almost a foot taller than the diminutive Abigail. Despite their age disparity and height differential, Abigail and "Ray" got along well.

#### **"Ray" the White-naped Crane**

To collect semen from male cranes requires catching and restraining them. Once caught, a male is held by one handler with its body between the handlers legs and the crane's head (and dangerous beak) behind the handler and facing away from the handler's back. The bird is primarily restrained by the handler applying pressure from their legs around the cranes body while massaging the male's thighs. To facilitate the male producing a semen sample, the crane must be restrained gently enough

to allow the bird to stand upright but still firm enough to prevent escape. A second person kneels down and manually massages the male's lower abdomen, lower back, top of the tail, and cloacal area. When stimulated properly the male's cloaca will begin to pulsate. When this happens the second person gently everts the cloaca while holding a shot glass right up to the cloacal vent to collect the semen droplet. Once the crane is carefully released and the keepers have vacated the enclosure, a syringe with semen extender is used to draw up the sample and the sample is quickly transported for the A.I. of the female. After the A.I., the small amount of semen remaining in the



**1.0 White-naped Crane "Ray"**

syringe is looked at under a microscope to check for the presence of sperm and determine its viability, concentration and mobility.

Once captured and restrained, Ray always produced quality semen samples and was very cooperative during the semen collection procedure. The only problem in collecting semen from him occurred during the initial capture and later release. We typically capture our cranes by methodically herding them into a corner of their enclosure and safely but quickly capturing them once they turn their back to us while facing the corner. Cranes respond to threats by pecking with their beak (usually toward the eyes) and jumping and kicking their legs to rake the perceived threat with their claws. So we wait until their back is turned to protect ourselves from their pointed bill and sharp claws. However, Ray is our only crane that refuses to turn his back on us when herded into a corner. The five-foot tall male will turn and directly face us whenever we approach closely. This made him an excellent defender of nests, eggs, and chicks but a bit of a challenge for semen collection. We learned to wear safety

goggles and adapt our capture approach. By extending a broom towards Ray, a keeper can entice the male to peck at the broom and then quickly grab the bird's neck and corral the body. Releasing Ray is just as much of a challenge because he will turn around and attack as soon as we let go of him.

Remember that during the semen collection, the male crane is restrained by holding its body between the handler's legs and holding the bird's thighs by hand. Releasing the bird involves removing our hands from his thighs, relieving our leg's pressure on his body and allowing the male to walk under our legs and out the other side. Initially upon such release, the male is facing away from the handler's back but is in very close proximity to the handler who has limited visibility to the crane behind him. Ray would immediately turn around to face us and often attack. We learned to safely release Ray by giving him a gentle push as his handler lets go and extending a broom towards him to draw his aim away from our face if he decides to attack. Since employing a broom, Ray typically lets us off with just a threat display after his release.

### ***Breeding Abigail and Ray***

The semen collections and artificial inseminations went smoothly and effectively once Abigail and Ray were trained. Because neither bird had ever raised chicks before we gave their first chick to an experienced pair to foster raise as their own. We didn't want to risk leaving such a genetically valuable chick with first-time parents. In exchange, Abigail and Ray were given the fertile egg from a common Florida Sandhill crane pair to hatch, incubate, and raise as their own. They turned out to be excellent parents and in the future were allowed to raise their own chicks and eventually foster-raise other chicks.

Twice during their pairing Ray has become aggressive towards Abigail during the start of breeding season. The first incident occurred early on in their pairing and was likely due to the female's inability to allow the male to copulate. The second incident happened two years ago when Abigail was egg bound. The male probably responded harshly to behavior by the female that he could not understand. In both cases, the male was temporarily separated into an adjacent pen. Once Abigail laid her first egg, Ray was allowed back into her pen and predictably focused his attention and energy on keeping perceived predators (i.e. keepers, passing cars, etc) away from his precious nest. As a precaution we separate the pair every spring near the average lay date for the female's first egg of the year. While separated, Abigail always lays her first egg in a nest alongside the common fence line with Ray and once she has laid her egg we let him rejoin her.

Through A.I. we produced one chick from the pair in 2002 and a second chick in 2003. Both chicks were hatched healthy and raised wonderfully by their parents. In addition, Abigail and Ray provided four fertile eggs to an effort to reintroduce White-naped cranes to the wild. In cooperation with other accredited zoos, her fertile eggs were sent to Russia to be incubated, hatched, raised, and released to the wilds of Muraviovka Wildlife Reserve. The two are such model parents that they have foster-raised five chicks from eggs produced by other White-naped cranes. In 2009, Abigail and Ray foster-raised their granddaughter, a female chick produced from A.I. involving their male chick from 2002.

### ***Artificial Insemination without Restraint***

Artificially inseminating cranes normally requires a crane to be stationary while being stimulated and inseminated. This entails capturing the crane and manually restraining it during the entire procedure. While this type of A.I. is very effective in producing the desired results of representing the bird's genetics, the handling is stressful for the cranes. Their stress level complicates the A.I.'s efficiency by often causing them to defecate during the procedure. There is no alternative to restraining the crane when dealing with cranes requiring A.I. due to physical limitations. But for female cranes with the behavioral problem of having imprinted on people we have developed a preferred alternative. By training the imprinted cranes to accept A.I. without restraint we used each bird's problematic behavior to both the bird's and the species' advantage.

### ***“Walnut” the White-naped Crane***

Walnut the White-naped crane arrived at NZP-CRC in 2004. She had been hand-raised at another institution and therefore imprinted strongly on her human caregivers. Walnut directed all her social behavior towards her keepers and never learned to recognize or treat other cranes as her fellow species. Walnut was not only intolerant of other cranes; she was downright hostile and killed several males during attempts to pair her with male cranes at other zoos. Because of her imprinted nature, Walnut had never produced any offspring when she arrived here at the age of 23. At the time, this made her the most genetically valuable White-naped crane in captivity. We knew right away she would have to be housed alone and never paired with a male. Through artificial insemination we produced four female chicks from her, two in 2005, one in 2007 and one in 2008. In 2007 we thought of a way to improve both the efficiency of A.I. and Walnut’s quality of life during the A.I.

The imprinted Walnut would always greet her keepers very excitedly, especially during the breeding season. I am her primary keeper and eventually Walnut began to take a special interest in me and I became the exclusive target of her courtship displays. She would dance around me; head bob, toss objects and elicit her half of a unison call. Despite my best efforts I was never able to replicate my half of the unison call, but I could at least bob my head, give her mealworms and mice, help her build a nest, and praise her with compliments. Our interactions outside the breeding season were much the same and I made a point to spend time with her to increase our bond and her comfort level with me. Despite her tameness, Walnut would only allow me so close before moving away. Even at the height of breeding season I could only approach to within a few feet of her before she would walk away and then resume her courtship behavior.



**0.1 White-naped Crane “Walnut”**

I began training Walnut for A.I. without physical restraint prior to the 2007 breeding season. I started by reaching my hand towards her while saying the word “touch”. Initially she would step away before I could even touch her. After some time Walnut would allow my hand to touch her back before walking away. I would reward her with a pinkie mouse and verbal praise. Gradually Walnut learned to associate the sound of the word “touch” with my reaching out to her, the fact that I did her no harm in touching her, and with the mouse reward. I was eventually able to pet her entire back before she moved off. This all laid the groundwork for further contact once breeding season began. Walnut would solicit me to mate with her by turning her back, lowering her head, and opening and trembling her wings. In the past, she would only solicit me briefly and would stop as soon as I got within a few feet. But after training her to allow me to touch her back with my hand, she became much more accommodating and comfortable. Walnut began to allow me to touch her legs and later manually massage them as is necessary to stimulate her for A.I. It was a gradual process of her allowing longer and more contact each day. Once again, her rewards for the desired behavior of standing still were pinkie mice and verbal praise.

At the peak of the breeding season, the actual physical contact became a reward in itself for Walnut who would purr loudly and the pinkie mice rewards were no longer necessary. The next step was to massage toward her cloaca with one hand while holding a syringe in the other. This required that I stop massaging her thighs which was at first very disappointing for Walnut and would cause her to

walk away as soon as I stopped. I learned to transition from massaging her thigh with both hands to massaging her cloaca with one hand quickly enough that she stayed receptive and stationary. This physical stimulation causes a female crane's cloaca to pulsate, indicating her readiness to accept breeding which in this case was an empty syringe that would be complete with a semen sample in the future once Walnut was trained. Once stimulated enough, Walnut would accept the syringe and insemination could be conducted. I would gently spin the syringe into the left side of her now naturally lubricated cloaca. While continuing the stimulation, I would inject the syringe. The stimulation continued until Walnut would step away and the syringe fell out on its own. Once Walnut accepted this entire process we began to collect semen samples from her SSP® declared mate and I conducted the actual A.I.

The success of her training came to fruition when Walnut laid fertile eggs. Her eggs were given to an experienced pair of White-naped cranes to incubate, hatch and raise as their own. These experienced birds were Abigail and Ray, who was the biological father of the two chicks. We did not leave the egg with Walnut due to her imprinted nature and to spare her the difficulties of having to do the incubating and rearing job of two cranes. Walnut defended her eggs when we came to take them from her but would recover her friendly nature soon afterwards. The success of her training had the unintended results of causing Walnut to continue to solicit even moments after an insemination. She clearly enjoyed the process and would solicit me multiple times per day. It also increased her normal crane territoriality to a degree that caused her to attack any keeper other than me. Needless to say, the entire process and results made Walnut and I a frequent topic of amusement amongst my co-workers.



"Walnut's" Chick

Walnut was sent to NZP-CRC because other zoos had failed to breed her and through our efforts she has produced four valuable female chicks. Her genetic representation in the population is now sufficient enough to preclude the need for additional offspring in the near future. But Walnut and I continue to enjoy each other's company throughout the year and go through A.I. training every time she solicits me during the breeding season. In 2009, Walnut became a grandmother when her 2007 chick had a chick of her own while paired with a male at the Toledo Zoo.

#### *"Amanda" the White-naped Crane*

Amanda the White-naped crane was 19 years old when she arrived at NZP-CRC in 2008. She had lost her mate at another zoo and was sent here for re-pairing. Amanda had been housed together with her prior mate and laid eggs, but had never hatched any chicks. Soon after her arrival, we began to understand why. Amanda would approach us closer than our other cranes (except for Walnut) and exhibited a tameness that revealed she must have been hand-raised and imprinted on people. Once breeding season rolled around, Amanda displayed courtship behavior towards her keepers by dancing and head-bobbing. She would also briefly solicit both male and female keepers removing any doubt that she was imprinted.

Because of her previous pairing we were willing to try carefully pairing Amanda here, but she had arrived too late in 2008 to be paired. As a back-up plan for the next breeding season I began training her to accept A.I. without any restraint. Amanda was much more tolerant to my approach and physical contact than Walnut. A process that took months with Walnut was accomplished in weeks with Amanda. Her rapid acceptance of the stimulation and insemination process was hampered by

one quality that even the notoriously ill-tempered Walnut, who remember had killed two male cranes, did not possess. Amanda would occasionally and without warning go from purring with enjoyment at being stimulated to turning around and pecking at my face. During crane A.I. it is necessary for me to get down on one or both knees to be at the proper height to see what I'm doing. This puts me at a very vulnerable position should the soliciting female have a sudden and violent change of mind. Once Amanda turned around she would not only be inches away but also be striking at me from above. Thankfully over time, and after I donned protective eyewear, Amanda's attacks decreased and eventually disappeared entirely.

My guess is that despite her seemingly quick acceptance of the process, Amanda was not as comfortable as she appeared and her attacks were signaling such discomfort. Where Walnut would step away when uncomfortable, perhaps Amanda would attack. I continued to train Amanda whenever she would solicit me and also provided her with nesting material that often seemed to be her most prized reward. There was one very awkward moment when I mistakenly called her "Walnut". Whether Amanda understood my distraction or not, she clearly recognized it as a word or sound she hadn't heard from me before. Amanda immediately stopped soliciting and abruptly turned back to look at me. If there was ever a time for her to attack me that was it, but I was thankfully able to woo her back quickly with some mice.

Unlike Walnut, we were willing to attempt to pair Amanda with a male recommended by the SSP® in 2009. Amanda and the male were initially housed side by side in adjacent yards to monitor their interactions along the common fence line. They began unison calling prior to breeding season and frequently danced and head-bobbed. Once she was alongside the male crane, Amanda stopped displaying courtship behavior towards me but retained her tameness and tolerance of my close approach. Amanda's imprinted nature created the possibility the crane pair would not get along, but we observed no aggression or displacement behavior between the two and allowed them supervised access to the same pen. Once breeding season began, Amanda became less tolerant of my approach and would frequently make threat displays towards me. We still kept a close eye on the pair and monitored them for any incompatibility.

One afternoon I checked on the pair and found Amanda hiding in the ornamental grasses in a corner of her pen. This is never a good sign and I quickly herded the indifferent male into a separate pen. As I approached Amanda, she slowly stood up and her body was quivering. There were no wounds visible but she was clearly traumatized. After ignoring my presence while getting along with the male, she now stepped right up to me seeking reassurance. She allowed me to place my hand on her back as I examined her. After an exam by our veterinarian it was determined that Amanda had no physical injuries but her behavior clearly indicated she had been on the receiving end of the male's aggression. We suspected that her imprinted nature might have played a role in the pair's sudden incompatibility. Amanda and/or the male crane may have gotten their signals crossed or the male may just have been too eager to mate while she wasn't fully receptive yet. Amanda remained stressed for several days and I soothed her by keeping her company and offering her favorite food, dead pinkie mice. The male was moved out of view from Amanda to facilitate her recovery.

After a few days, Amanda began greeting my approach with dancing and head-bobbing and eventually soliciting for me to mate with her. At the end of the previous breeding season and prior to her introduction to the male crane, I had trained her to accept A.I. without any physical restraint. Remarkably, we were able to pick right up where we had left off. We began semen collection from her abusive mate and inseminating Amanda in hopes of producing her first ever chick. The male was now housed next to a younger female both for companionship and to keep his hormones at breeding levels. A few weeks after we began collecting semen, the younger female next door was sent to another zoo to be paired with another male. Now housed away from both Amanda and his younger companion, the male stopped producing good semen samples.

As an insurance policy against an unsuccessful insemination or an embryo failing to survive to hatching, we keep attempting A.I. whenever possible until an egg hatches successfully. We needed to move the male next door to a single female in hopes of bringing him back into breeding mode. Unfortunately the only single female cranes we had were his ex, Amanda, and Walnut, who had killed males at another zoo. Unwilling to tempt Walnut's vengeance, we reluctantly moved the male back next door to Amanda and monitored them closely. We would only leave him next door if Amanda approved and despite their past trouble she was not at all troubled by his presence. Amanda did not begin returning the male's instant courtship displays but would comfortably hang out with the male along the common fence line of their adjacent pens.

Though we conducted many inseminations to improve our chances for producing a chick, with great luck I was able to successfully inseminate Amanda on the first attempt. We took her egg and gave it to Abigail and Ray, the same experienced foster pair of White-napped cranes that had previously raised Walnut's chicks. These foster parents were actually the parents of Amanda's estranged mate, making them grandparents of the female chick they would successfully incubate, hatch and raise. The female chick replaced her biological mother as the most genetically valuable White-napped crane in captivity. Amanda and her mate are currently housed side-by-side and getting along well. They frequently unison call and Amanda has once again lost interest in me, except for viewing me as a convenient source of delicious mice. We expect to have to keep them separated and perform A.I. if they are recommended again as a breeding pair.

### **Conclusion**

Breeding any endangered species is fraught with difficulties and the complexities of crane behavior and breeding only complicate the endeavor. The stories of Abigail, Walnut, and Amanda are prime examples of the significant obstacles to improving the genetics of the captive population of White-naped cranes. Performing A.I., and A.I. without physical restraint helped us confront and overcome these obstacles. Through A.I. we produced two chicks from Abigail and two chicks from Walnut. By using A.I. without restraint we produced two more chicks from Walnut and one chick from Amanda. Our methods have enabled us to enhance the efficiency of A.I., improve our birds' quality of life, and strengthen the genetic stability of the White-naped crane SSP® population. We look forward to continuing our efforts with White-naped cranes, incorporating those techniques to other crane species, and sharing our knowledge with colleagues.



**Keeper's Hand and Crane's Footprint in the Snow**

*All photos by Chris Crowe*

# Enrichment and Training...It's For the Birds

By Dawn Neptune, Utah's Hogle Zoo; Diane Olsen, Moody Gardens; Tammy Root, Indianapolis Zoo; Robin Shewokis, The Leather Elves; Catherine Vine, Philadelphia Zoo and Deana Walz, The Living Planet Aquarium

It has been said that birds are one of the most challenging groups of animals to enrich. Many zoological facilities house birds in naturalistic exhibits with many other species which can make it more complicated to design a behavioral enrichment program for individual birds. It may be difficult to enrich birds, but with some creativity, behavioral goal setting, and an open mind, it can be accomplished.

When you begin developing an enrichment behavioral husbandry program, you must start by researching the natural behaviors of your species. Often it is this process that leads to the creation of new enrichment ideas. Once the natural history has been researched, also consider the individual history of the individuals (if known) as well as facility constraints. It is from here that you can begin to set goals that you want your program to accomplish. Behavioral goal setting is the backbone to a strong, well-rounded behavioral husbandry program.

Training is also an integral part of a balanced behavioral husbandry program. It becomes very useful when establishing a core set of husbandry behaviors. During stressful events such as moves to new exhibits or veterinary exams, enriched birds tend to be calmer and recover more quickly. Training birds for husbandry behaviors such as crating puts a lot less stress on the keeper and the bird during these situations. In addition, training and enrichment can facilitate breeding by increasing comfort in the environment, decreasing aggression between potential pairs, and in some cases even lead to successful artificial insemination. As wild bird populations continue to decrease at an alarming rate, keeping and breeding healthy birds that retain a large repertoire of natural behaviors may very well be essential to the preservation of many avian species.

To get the brainstorming process started, we have given you some suggestions for taxon behavioral goals, as well as some enrichment and training ideas to help you achieve them. Remember, it is extremely important to observe any enrichment activity for any problems and to ensure you are targeting the goals set in your program. The safety of all enrichment should be carefully considered, and birds should be monitored with any new enrichment.

## **Passerines**

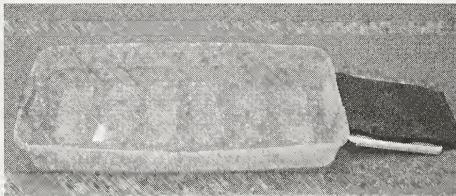
Behavioral goals: nest building, perching, vocalizing, foraging, courtship, preening, bathing, husbandry training

Enrichment ideas to achieve behavioral goals:

- ❖ Nest Building:
  - Provide a variety of nesting material (grasses, raffia, wood wool, branches, nest cups, platforms, hay),
  - Adjust perching to facilitate nest structures as needed
  - Create visual barriers from the public and staff to accommodate shyer, more secretive birds.
- ❖ Perching:
  - Provide a variety of perching types (grapevine, horizontal perches, branching perches) at a variety of heights
  - Rotate perching
  - Provide trees and other plants for perching
- ❖ Vocalizing:
  - Play recorded sounds of same and different species
  - Hang bird-safe mirrors
  - Provide visual access to birds of same and other species in separate enclosures



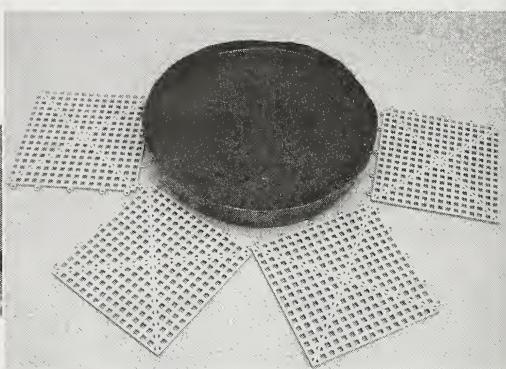
A green aracari checks out a fruit kabob. (Photo: Catherine Vine)



One option for a bath pan for birds in holding. (Photo: Catherine Vine)



A penguin finishes his “painting” enrichment - note paint footprints on floor. (Photo: Jenny Thompson)



Plastic storage containers make great pools for small ducks in holding. (Photo: Catherine Vine)



Parrot toys and whole fruit are great enrichment for toucanets and aracaris.

(Photo: Catherine Vine)

- ❖ Foraging:
  - Provide live insects for insectivorous birds
  - Cut fruit in large chunks and spike on kabobs or on perches
  - Sprinkle seed on the cut end of a head of lettuce and spike on perches (for seed eaters)
  - Hide mealworms or waxworms in the cut end of a head of lettuce and spike on perches (for insectivorous birds)
  - Use PVC or plastic puzzle feeders with holes to hide insects or seed (Wiffle® balls also work; PVC may be burned for a “natural” appearance if needed)
  - Sprinkle insects in water features (for insectivorous birds)
  - Provide different types of fruit and rotate on different days (there are many frozen fruits readily available that work well for passerines, such as peas, corn, blueberries, blackberries, etc.)
  - Change the location of feeders
  - Toss insects in air for aerial hunters
- ❖ Courtship:
  - Provide conspecifics if possible
  - Play recordings of same species
  - Provide a bird-safe mirror for single birds
  - Provide a “flush” of insects (many birds increase protein during courtship and while raising chicks)
- ❖ Preening:
  - Provide water features or dishes that allow for bathing
  - Provide a mister/sprinkler for bathing
  - Provide preening toys (cotton or sisal rope)
  - Provide sand or dirt for bathing
- ❖ Bathing:
  - Provide water features or dishes that allow for bathing
  - Provide water mister/sprinklers (automated or motion sensor)
- ❖ Training:
  - Hand-feed
  - Scale
  - Crate/shift/trap cage
  - Target to object or finger point/station

## Psittacines

Behavioral goals: social, challenge/task oriented, preening/bathing, nest building/chewing, vocalizing, foraging, husbandry training

Enrichment ideas to achieve behavioral goals:

- ❖ Social
  - Spend time with socialized birds throughout the day (training sessions, etc.)
  - Provide visual access to other psittacines (if possible)
  - House in pairs or family groups (if possible)
- ❖ Challenge/task oriented
  - Provide with puzzle feeders, boxes, mirrors, toys with a variety of materials, etc.
  - Shape the skills necessary for the bird to complete the task for complex feeders (if needed)
- ❖ Preening/Bathing
  - Provide water features or dishes that allow for bathing
  - Provide water mister/sprinklers (automated or motion sensor)
- ❖ Nest Building/Chewing
  - Provide with a variety of nesting materials
  - Provide visual barriers (plants, screens, etc.) for shyer birds
  - Provide a variety of chewable toys or chunks of wood
  - Provide with nest logs and cavities
- ❖ Vocalizing
  - Provide visual access to other birds
  - Play recorded sounds of a variety of bird species
- ❖ Foraging
  - Scatter food within the enclosure, both on ground and spiked or hung on perching
  - Rotate food options
  - Provide with whole nuts

❖ Training

- Hand feed
- Scale
- Crate
- Shift
- Sit on hand (if desired for demonstrations, etc.)
- Fly to hand (if desired for demonstrations, etc.)
- Blood draws, cloacal/choanal swabs, and other veterinary procedures

**Raptors**

Behavioral goals: roosting, hunting, manipulation, husbandry training

Enrichment ideas to achieve behavioral goals:

❖ Roosting

- Provide variety of perches for bird to choose from
- Provide perching behind sheltered areas for privacy
- Screen roosting area with live or artificial plants

❖ Hunting

- Play audio recordings of prey species
- Change location of provided food
- Hide food under natural (branches, stumps, etc.) or artificial (boxes, phone books, etc.) objects

❖ Manipulation

- Provide varied perching with different wrapping on the perch (sisal rope, Astroturf®)
- Provide various foot toys (Kong® toys, etc.)

❖ Training:

- Scale
- Crate
- Voluntary beak and nail trims
- Voluntarily allow jesses and leashes (if desired for programs, etc.)
- Step onto hand (if desired for programs, etc.)
- Fly to and from hand and perches (if desired for programs, etc.)

**Penguins**

Behavioral goals: swimming, exploration, nesting/breeding, husbandry training

Enrichment ideas to achieve behavioral goals:

❖ Swimming

- Free feed in water to entice bird to swim
- Train bird to come to a whistle for food in the water

❖ Exploration

- Place items of interest, such as mirrors, Wiffle® balls, mobiles and chalk drawings in various parts of the exhibit or holding.
- Place frozen ice blocks and artificial kelp in various parts of the exhibit
- Provide kiddie pools with ice water
- Provide towels (no frayed edges or holes)

❖ Breeding

- Provide nesting materials (grass, leaves)/boxes/substrates (dirt, sand)
- Provide a variety of different nest rock or box set-ups

❖ Training

- Shifting
- Scale
- Feet present
- Crate
- Voluntary blood/semen collection/artificial insemination

**Toucans, Aracaris, Toucanets**

Behavioral goals: foraging, play/manipulation, breeding, social opportunities, training,

Enrichment ideas to achieve behavioral goals:

❖ Foraging

- Place favorite treats in various parts of the exhibit
- Cut fruit in large chunks and spike on kabobs or branches
- Rotate feeders

- Scatter/hide insects, toss insects in air
- Provide insect puzzle feeders

❖ Play/Manipulation:

- Provide hanging parrot toys
- Off-exhibit: acrylic, bells, sisal rope, beads, wooden blocks, plastic rings, Dixie® cups, Easter eggs, balls
- On-exhibit: natural wooden blocks, sisal rope, leather, bamboo, pieces of perching
- Provide with live plants
- Provide mobiles

❖ Breeding

- Provide a variety of nest logs and cavities
- Provide nesting material

❖ Social opportunities

- Provide with opportunities to see other birds (if possible)
- Provide with bird-safe mirrors

❖ Training

- Hand-feed
- Scale
- Crate/shift
- Target/Station
- Trade (if birds gain access to dangerous objects)

**Waterfowl**

Behavioral goals: swimming/bathing, preening, foraging, social, breeding, training

Enrichment ideas to achieve behavioral goals:

❖ Swimming/Bathing:

- Provide with large water tub if off-exhibit
- Provide with a large water feature at least 8 inches deep (~20cm) if on-exhibit

❖ Preening:

- Provide with bathing opportunities
- Provide a mister or offer bath from hose (mist setting)

❖ Foraging:

- Scatter food on ground
- Scatter food in water
- Provide with whole lettuce heads
- Scatter insects on land or in water
- Provide mud area for dabbling
- Toss fish in water for mergansers and other appropriate species
- Sink and weigh down food under water for diving ducks

❖ Social:

- Keep in groups of same species if possible
- Keep with other waterfowl if possible
- Provide bird-safe mirror for single birds

❖ Breeding

- Provide various substrates and/or nest boxes
- Provide planted areas for birds to hide

❖ Training

- Scale
- Crate/Shift
- Target/Station

**Columbiformes**

Behavioral goals: nest building, perching, vocalizing, foraging, courtship, preening/bathing, training,

Enrichment ideas to achieve behavioral goals:

❖ Nest building:

- Provide nest baskets or nest platforms
- Provide nesting material (grass, sticks, hay, plant trimmings)

❖ Perching:

- Provide a variety of perching types (grapevine, horizontal perches, branching perches)

- Rotate perching
- Provide trees and other plants for perching
- ❖ Vocalizing:
  - Play recorded sounds of same and different species
  - Hang bird-safe mirrors
  - Provide visual access to birds of same and other species in separate enclosures
- ❖ Foraging:
  - Sprinkle seed on cut end of lettuce heads and spike on branches (for seed eaters)
  - Cut fruit in large chunks and spike on branches (for fruit eaters)
  - Scatter seed on ground (for seed eaters)
  - Change locations of feeders
- ❖ Courtship:
  - Provide conspecifics if possible
  - Play recordings of same species
  - Provide a bird-safe mirror for single birds
- ❖ Preening/Bathing:
  - Provide water features or dishes that allow for bathing
  - Provide a mister/sprinkler for bathing
- ❖ Training:
  - Scale
  - Crate/Shift
  - Station

## **Coraciformes**

Behavioral goals: nest building, perching, vocalizing, foraging, courtship, preening/bathing, training

Enrichment ideas to achieve behavioral goals:

- ❖ Nest building:
  - Provide nest cavities or soft logs
  - Provide nesting material (grass, sticks, hay, plant trimmings)
- ❖ Perching:
  - Provide a variety of perching types (grapevine, horizontal perches, branching perches)
  - Rotate perching
  - Provide trees and other plants for perching
- ❖ Vocalizing:
  - Play recorded sounds of same and different species
  - Hang bird-safe mirrors
  - Provide visual access to birds of same and other species in separate enclosures
- ❖ Foraging:
  - Toss insects in air for aerial hunters
  - Toss fish in water (for kingfishers)
  - Provide live insects
  - Change locations of feeders
- ❖ Courtship:
  - Provide conspecifics if possible
  - Play recordings of same species
  - Provide a bird-safe mirror for single birds
- ❖ Preening/Bathing:
  - Provide water features or dishes that allow for bathing
  - Provide a mister/sprinkler for bathing
- ❖ Training:
  - Scale
  - Crate/Shift

Training can be an integral part of a balanced Environmental Enrichment program. It becomes very useful when establishing a core set of husbandry behaviors. During that dreadful veterinary exam, your bird can be calm and collected if he or she understands what a scale or even a stethoscope is. Training birds for these particular behaviors puts a lot less stress on the keeper and the bird during their exams.

If you are new to bird training or just need a refresher, below are some ideas for bird training behaviors. Please be aware that these are just the very basics and within the steps of each behavior and depending on your bird, you may have to take smaller approximations.

### **Scale Training**

- Show bird scale
- Put treat on scale
- Give treat to bird as bird stands on scale

### **Blood draws**

- Drawing blood from sinus just above tail
- Applying pressure on sinus with finger
- Applying pressure on sinus with end of paper clip to act as a “needle”
- Drawing blood from jugular
- Apply pressure on neck
- Gradually get bird comfortable to neck being stretched
- Apply pressure on jugular with end of paper clip to act as a “needle”

### **Nail Trims**

- Get bird comfortable on platform that nails will be trimmed on
- Get bird comfortable with feet being held
- Start slowly and trim just 1-2 nails at a time
- Gradually get bird to station long enough to trim all nails

### **Wing Clips**

- Station bird
- Get bird used to wings being lifted by trainers
- Get bird used to seeing scissors
- Gradually get bird used to feathers being trimmed

### **Tactile**

- The more you can handle your bird, the better! This allows keepers to be able to check preening glands, molting issues, feet problems, etc, etc.

### **Recommended websites for a number of great devices:**

<http://www.chopperstoys.com/CatalogNaturals.html> (love their ‘Nature’s Naturals’!)

<http://www.estarbird.com>

<http://www.theleatherelves.com/main/index.php>

<http://www.busybeaks.com>

<http://www.birdsjustwannahavefun.com>

<http://www.naturesinstinct.com>

<http://www.parrottoy.com>

<http://www.twinleather.com>

<http://www.creativeforagingsystems.com/products.html>

[http://www.fauna-tek.net/parrot\\_models.htm](http://www.fauna-tek.net/parrot_models.htm)

### **Other good enrichment websites:**

<http://www.animaltraining.org>

[http://www.aazk.org/committees/enrichment/comm\\_enrichment\\_birds.php](http://www.aazk.org/committees/enrichment/comm_enrichment_birds.php)

# Jess Free

By Stephanie Ashley, Bird Programs Manager  
Tracy Aviary, Salt Lake City, UT

Bird training is a difficult venture. Here is an animal that thinks and moves differently from us. It can be difficult to pinpoint a bird's motivation, and even more difficult to secure it. When you add that to the challenge of working with an animal that can simply fly away from you, it is easy to understand why so many of us depend on physical control.

One of the most common forms of physical control seen in modern (and ancient) bird training is the use of "jesses" – those long leather straps which can be attached to a bird's legs and held by a handler. It isn't the only method used, though. Bird trainers also commonly practice holding a bird's toe or foot to keep it from flying away. It is also common to trim flight feathers and, for some species, even surgically remove part of the wing. And we do all this for one specific purpose: to have complete control over a bird's ability to fly away from us.

When I was introduced to the world of professional bird training five years ago, I had already dabbled as an amateur. I had learned to clip my own pet birds' wings, and I was proficient at using a toe hold on a parrot and applying jesses to a Kookaburra (*Dacelo novaeguineae*) as a docent at the local zoo. My education continued as a new professional with jessed raptors, a Kookaburra, a Black-billed magpie (*Pica pica*), and a Red-crested turaco (*Tauraco erythrolophus*). I also learned how to use a foot hold on our American crow (*Corvus brachyrhynchos*), and toe holds were still mandatory for parrots. I quickly learned not to trust the birds, because they might fly away. The big exceptions were the vultures. I have never worked a vulture with jesses, and was taught other ways of managing them.

Then, in 2007 our world of perfect control was rocked by training consultant Phung Luu, who was hired by Tracy Aviary to teach us to be better trainers. One of his initial recommendations was that we remove the jesses from our magpie, kookaburra, and turaco. The reasoning was simple: their legs are structured differently from the tendon-and-muscle reinforced legs of a raptor, and they could be injured. We supposed that we had always known this, or why would we have a policy of cradling these biting birds in our free hand? We made this change immediately, but were nervous about it. What would happen when we removed our safety net?

As it turns out, when you teach a bird the right behavior and pair it with the right motivation and reinforcement, they can learn to: A) not fly away and B) come back when they do fly away. Suddenly, our birds were able to make choices. Real choices. And somehow, that increased their confidence in themselves and in us. The results were remarkable: birds that didn't bite and rarely flew away. When they did fly away, they were quicker to return.

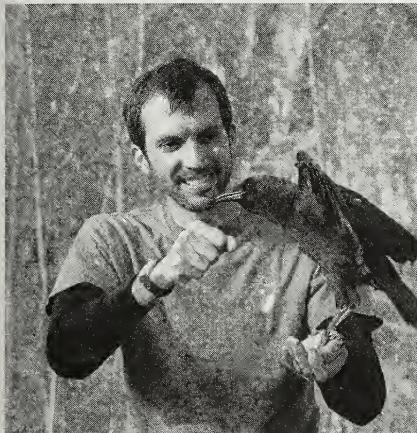
That same year, Phung was working on a training project with our crow. He was teaching her to fish out a piece of meat with a hook. At the same time, we were preparing her routine for our summer show. During one of our sessions on stage, the crow decided to fly into a tree. We immediately sprang into action, trying to coax her down, knowing that as soon as she flew to a hand we would seize her foot and she would be trapped. She knew this, too, and stayed a careful distance away from us. In the meantime, Phung climbed onto the roof with a few pieces of her food, and quietly called her. To my amazement, the crow responded to him.



Our King Vulture (*Sarcoramphus papa*) is one of our most consistent and reliable birds. She is frequently flown outdoors with no jesses or other physical restraints.

(Photo: Bruce Thompson)

As I watched our crow fly to Phung, a part of me was screaming at him to grab her before she got away again. He did not. The crow went to him, took a small piece of food, and then flitted off. But she didn't go quite as far as she had gone before, and when she returned for more, she did it more quickly and stayed longer. I will never forget how I felt when the bird I had been working with for nearly three years chose the man she had known for only a week over me. It was more than embarrassing, it was humbling. It took a little while to get her back into her enclosure, but every time she came down, she went to Phung rather than fly to any one of us.



Maleficent, the American Crow, now thrives without a foot hold. She is reliable both indoors and out of doors, and has been trained to both fly-free and manipulate a variety of prop items. (Photo: Bruce Thompson)

It seems so obvious in retrospect, but I didn't realize until that day that jesses and foot holds are the same thing. We began practicing letting go indoors. Our crow was fantastic without a foot hold, and she soon began performing as well for us as she did for Phung. We noticed that during indoor programs she would sometimes walk or fly through the audience, exploring, but she always returned when we called her. Interesting.

We were adventurers in training who had, with a great deal of assistance, made a new discovery. We excitedly babbled about our birds' newfound personalities in our short meetings. One day, after hearing our excitement, Phung said, "imagine working raptors without jesses."

And we laughed at him. Imagine! After all, EVERYBODY knows that you're supposed to use jesses with raptors, right? Right? It's just the way things are. Phung smiled at us politely when we told him we weren't ready for THAT yet. And we weren't.

Perhaps to prime us for being "ready" to wean ourselves off our dependence on jesses, he had us fly raptors without touching the jesses. We learned to not automatically reach for the jesses when the bird landed on the glove. Sometimes we succeeded. Sometimes we were just too afraid to let go.

Time passed, and we didn't come any closer to abandoning our jesses. We acquired a new Turkey vulture (*Cathartes aura*), and I trained her in the way with which I was familiar: without jesses. Isn't it funny how we can fool ourselves into believing that one thing is different from another? To another trainer, a vulture IS a raptor, and requires the same equipment. How is working a vulture with no jesses different from working a hawk with no jesses? I allowed my mind to trick me into thinking they were different, and thought nothing more of it.

We also acquired an Osprey (*Pandion haliaetus*). We tried, unsuccessfully, to glove train her with jesses. It wasn't until my co-trainer attended the 2009 IAATE conference that we began to see things differently. After watching an interesting presentation about a snowy owl that preferred not to stand on the glove, he wanted to try applying the same principle to our osprey. "After all, we do it with our vultures."

This idea has snowballed into a new goal for our program: how can we become jess free? Two and a half years after Phung first suggested that jesses are just a crutch, we finally understand. We now fly our female Harris' hawk (*Parabuteo unicinctus*) entirely without jesses, and we do this routinely. We were surprised to discover her in a different context: what would she do if she could truly decide? Why, she would stay on the glove. When she leaves the glove, it is almost always to go to her next position, or to another trainer.

That's not to say that all our problems are solved. We have a couple of owls that will require a lot of training to become independent of their jesses. I'm reluctant to release the toe hold on a certain parrot that decided to sit in a tree for 36 hours. And I'm not sure what to do about a particular Rough-legged hawk (*Buteo lagopus*) that is missing an entire wing and would risk injury on the glove without the jesses there to catch her. But we are working on it. We have a goal now, and we are excited about it.

Removing jesses may be an extreme example of allowing a bird to make a choice, but there are many ways we can provide these opportunities. Safety should always be given first priority, and each program needs to adjust its methods and philosophies based on its abilities to continue to provide a safe environment for birds and guests. Remember that this philosophy can be implemented on the most basic levels: stepping up onto the glove, loading into a crate, and standing on a scale. My hope is that other programs can discover what ours did: birds empowered by choice are more confident, healthier, and happier.



Harris' Hawk Cazadora free-flies without jesses. She continues to wear alymeri anklets to accommodate jesses for tethering.

(Photo: Bruce Thompson)

# **Greater Flamingo (*Phoenicopterus roseus*) with Capture Myopathy: Specialized Care & Husbandry**

By Leanne Blinco and Beth Schille, Department of Animal Health  
Disney's Animal Kingdom®, Bay Lake, Florida

At Disney's Animal Kingdom® we have an extensive preventative medicine program that is part of our overall animal health program. Most animals are scheduled for an annual wellness exam which for birds may include: a physical exam, body weight measurement, blood sample collection and analysis, transponder placement (if necessary), radiographs (bi-annually), and administration of prophylactic medications or vaccines.

The annual wellness exams for the Greater flamingos (*Phoenicopterus roseus*) are performed adjacent to their exhibit which is part of our Kilamanjaro Safari guest experience. The exhibit consists of a large pool and an island that is 6.1 meters in diameter [20 ft.]. At the time, the exhibit housed 21.24.4 birds. For their exams, the birds are manually captured and restrained for approximately 15-20 minutes each.

The Greater flamingo is the largest of all species of flamingos. They can be found in parts of Africa, southwest Asia, northern South America, and southern Europe. Greater flamingos are the tallest of all flamingo species, averaging 120-145cm in height [3.9-4.7 ft.], 3.5kg in weight [~7.72 lbs.], and having a wingspan of 140-165cm [4.6-5.4 ft.]. Their habitat primarily consists of high alkaline or saline shallow lagoons, inland lakes, or mudflats. Diet is varied and may include aquatic invertebrates, insects, and plant matter. (del Hoyo & Sargatal, 1992)

This paper will discuss the specialized care and husbandry provided to a Greater flamingo that was diagnosed with capture myopathy following an annual wellness exam.

Capture myopathy, also known as exertional rhabdomyolysis, is a condition in which there is muscle damage as a result of a period of strenuous exertion such as running or struggling. The time from injury to appearance of clinical signs is variable from immediate to several hours. Rarely are initial signs of capture myopathy in birds noted after 24 hours. Clinical signs can range from peracute death due to cardiac failure to painful, stiff movement of varying intensity. Capture myopathy is a disease of muscle, but nerves, bones, tendons, and ligaments can also be injured during evasion, capture, or restraint. If nerves and tendons of the distal legs are involved, it is not uncommon for birds to "knuckle over" intermittently or continuously on top of the foot with subsequent injury to the skin. If tendons completely rupture, inability to stand or lift a wing may occur. Fracture injuries can be severe and are often recognized by palpation of the affected limb/bone and/or radiographs.

Diagnosis of capture myopathy can be difficult. If it is possible to touch the bird, hard and excessively warm muscles may be appreciated on palpation. If the bird survives with myopathy for a few days, reduction of subcutaneous and abdominal fat may be appreciated. In mammals, discolored urine due to excessive myoglobin release is sometimes noted and is a sign of impending kidney failure. A change in urate color should not be expected in birds suffering from capture myopathy. Blood work may be helpful in the diagnosis of capture myopathy. Serum chemistry values such as CPK and AST are often elevated in cases with extensive muscle damage.

During a routine capture for an annual wellness check, one of our female flamingos was transported to the hospital for further diagnostics. A second female was transported with her as a "companion bird" in the event that this bird would need to be hospitalized long-term. After the staff veterinarians medically discharged the flamingo in question, both birds were transported back to their exhibit. Upon release onto the exhibit island, the companion bird tangled her legs up in some weeds and

started to struggle. Once she was freed from the area she was unable to stand on her own. Following a thorough medical examination, including radiographs to rule out skeletal abnormalities, the bird was diagnosed with capture myopathy.



**Figure 1.** Flamingo in Sling

her own. Medications consisted of anti-inflammatory drugs, steroids, antibiotics, anti-fungal drugs, and fluid therapy. Physical therapy was performed to keep her muscles from atrophying. In addition to extending her legs by hand, the bird was placed in a large tub of warm water 2-3 times a day for hydrotherapy sessions (Figure 2). Keepers would broadcast food items into the water to encourage a feeding response. Finally, on Day 16, the flamingo was able to stand and support her own weight and on Day 20, she started to eat and drink on her own.

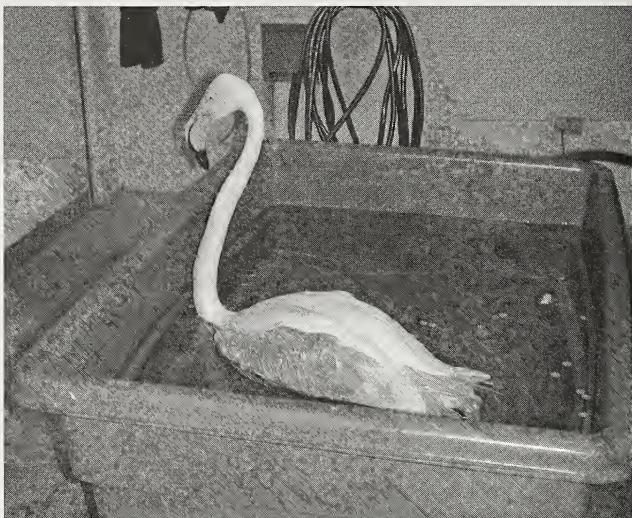
Once the bird was able to stand for short periods of time, the sling was transformed into a “walker”. Wheels were placed under each frame leg (Figure 3). This “walker” allowed the bird to walk down the hallway normally while the sling supported her body weight. After a couple days of using the walker she was able to walk on her own (Day 23). Thirty-eight days after being admitted into the hospital, she was released back onto the flamingo island with the rest of the flock (Table 1).

### Conclusion

Medical treatment for capture myopathy is often difficult and is primarily supportive in nature, allowing opportunity for the muscles to heal enough for return to function. The best way

The bird was unable to support her own weight, therefore a sling frame was constructed of PVC similar to that described by Ellis and Gee, 1996 (Figure 1). The sling offered the bird support while allowing her to extend her legs. The dimensions of the frame were 68.6 cm high x 66.0 cm wide x 91.4 cm long [2.25 ft. x 2.16 ft. x 2.9 ft.]. The actual sling was made by placing two towels together and layering a foam pad in between for support. There were three holes cut into the sling, one for each leg and one for the bird’s tail. The towels were attached to the frame by using large spring clamps.

Daily husbandry for the bird included: body weight measurement, tube feeding, medication administration, supportive care and physical therapy. The bird was tube fed a fish gruel but was also offered food and water at all times while she was housed in the sling. This was to help motivate her to eat on



**Figure 2.** Flamingo during hydrotherapy.

to deal with capture myopathy is to prevent it before it occurs. Changes have been made in our capture and restraint techniques here at Disney's Animal Kingdom® which has reduced the amount of time a bird is in hand during the routine exam process. Flamingo groups are now kept in makeshift holding pens and are isolated individually as needed which prevents them from pacing and becoming overheated. Due to the number of birds processed at one time, individual stations have been set up to accomplish medical tasks such as blood collection, physical examinations, and vaccinations. The birds that have been processed are then released back onto the island where the animal care team can observe them for any signs of post procedure complications.

The sling system utilized with this patient has also been used for other species of birds to treat injuries such as leg fractures, "knuckling under" of the foot (which requires a plaster "bootie") presumably due to nerve/tendon damage, and various other leg problems. We have found that the sling works best with light/smaller birds. These types of birds are less likely to tip the sling over to one side or the other.



**Figure 3.** Close-up of walker for Flamingo.

**Table 1:** Daily Husbandry/Progress Chart

Event	Date	Elapsed time
Unable to stand	26 March 2000	Admitted into hospital
Tube feeding	27 March – 14 April	19 days
Hydrotherapy	28 March – 15 April	19 days
Using "walker"	10 April	16 days after arrival to hospital
Eating/Standing in sling	15 April	20 days after arrival to hospital
Walking/Standing w/o sling	17 April	23 days after arrival to hospital
Bird exercised outside	18 April	24 days after arrival to hospital
Stand on own 24 hrs/day	26 April	30 days after arrival to hospital
Released from hospital	2 May	38 days after arrival to hospital

#### Acknowledgments

Thank you to Scott Tidmus and the West Savannah team at Disney's Animal Kingdom® for their help and support while this bird was in the veterinary hospital. Additional thanks to Lori Grady and Dr. Scott Terrell for editing this paper, and to Dr. Don Neiffer for providing additional content.

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# **Successful Rearing of an African Sacred Ibis (*Threskiornis aethiopicus*) Chick at the Toronto Zoo**

*By Lisa Torchetti and Charles Guthrie, Keepers  
Animal Health Centre, Toronto Zoo, Canada  
October-December 2009*

The African Sacred Ibis (*Threskiornis aethiopicus*) is a species of wading bird of the ibis family, Threskiornithidae. They are typically found in marshes, open moist areas, flooded farmlands, coastal lagoons in south-eastern Iraq, Madagascar and sub-Saharan Africa.

## **Housing**

The Toronto Zoo currently has a collection of 1.1.15 Sacred Ibis with several breeding pairs. The whole flock was moved to temporary holdings in our Animal Health Centre due to construction and renovation of their current habitat in the African Rainforest Pavilion. It was during this move on 6 October 2009 that three eggs were discovered on a nest built by the adult breeding pair. One of the three eggs had already started to pip and was moved to an incubator in the Animal Health Centre's ICU. The other two eggs that had not started to pip were put back with the adults in the new holding with hopes that they might resume caring for them. Due to the stress of the move and the bird's new surroundings, the adults abandoned the nest and the eggs were eventually determined to be non-viable and were discarded.

## **Incubation**

At 1245hrs on 6 October, the pipping egg was set up in an incubator with a temperature of 35°C (95°F) and a humidity of 50%. The entire top of the egg was already cracked and the chick inside was cheeping and moving around. The egg was checked periodically throughout the day, but by 1500hrs there was still no progress. The egg was misted lightly with distilled water and by 1700hrs, the chick hatched with some assistance. The chick was then examined by the veterinary staff. It weighed 36 grams (1.27oz.), a slightly lower birth rate than stated in literature, (Holland, 2007), but was found to be in good health. The yolk sac was fully internalized and the chick was resting comfortably in a bowl lined with a cotton towel with a few twigs for it to grip and help keep its legs together beneath it. The twigs also prevented the chick from lying too flat on the bottom of the bowl and possibly distorting its beak.

## **Hand Rearing**

At 0830hrs on 7 October 2009 the chick was heard chirping when staff arrived. It was moved to a brooder with a temperature set at 34°C [93.2°F]. It weighed 34.1g [1.2oz.]. It was not offered food yet to allow absorption of its yolk sac. By 1145hrs on the same day, it was offered approximately 0.5ml of a "slurry" made of ground up dog kibble and eye smelt in a 1:2 ratio, respectively, with vitamin E and thiamine. A bird hand-rearing formula (CéDé Birdfood) was added to help thicken the slurry and to add additional vitamins and nutrients. Every time the chick gaped it was fed from a 3ml syringe with the tip cut off. It was slow to eat but did swallow the food eventually with some guidance. The chick had difficulty consistently gaping wide enough to receive the syringe but the keepers solved this issue by making an "okay" symbol with their hands and pointing the index finger and thumb towards their chest. This created a hole in which the chick put its beak in to beg. This method was used to simulate the parents' beak covering a chick's beak during feeding. This worked quite well and by the next feeding it was already producing a fair amount of feces/urate. The chick was fed every hour from 0700hrs to 2200hrs and the amount increased in small increments depending on the chick's eagerness. The chick had gained weight from 34.1g to 48.4g by Day 4 [1.20-1.72oz.]. The feeding interval was also increased to every 1 ½ hr with the chick being very eager to eat and increasing in strength daily. Its neck muscles were getting stronger but the chick was still unable to support its own head completely. Its legs were also getting stronger and the chick was starting to

raise itself up on them and was already trying to climb out of its bowl!

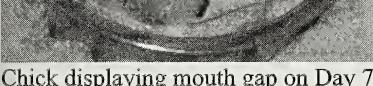
By Day 8 the chick was eating really well and was chirping loudly and impatiently before each feeding. The amount of food given was 10ml and increasing by around 2ml per day. The chick's weight quadrupled, weighing 140g [4.9oz.]. By this time the chick's eyes were almost completely open and it was showing more interest in its surroundings, preening its towel and itself.



African Sacred Ibis chick on Day 6

On Day 9 the feeding intervals increased to every two hours

with the last feed at 1900hrs. The chick was very satiated by this feed and would sleep the night without waking. On Day 12 the chick was offered food with a thicker texture and on a bent spoon to encourage it to feed itself. While it tried to peck at the food on the spoon, it was unable to pick it up and drop it into the back of its throat to swallow. It was still eating well with the assistance of the syringe and now weighed 303g [10.6oz.]. By this time the chick's down was fully in and its pinfeathers were growing so the brooder was turned down to 32°C [89.6°F].



Chick displaying mouth gap on Day 7

At Day 14 the chick was strong and big enough to be moved to a larger brooder, measuring approximately 4 ft. x 3 ft. x 3 ft. [0.91m x 1.22m x 0.91m]. This was kept at room temperature but supplemented with heat from a heat lamp clamped to the outside. The chick was also being weaned off of the 'slurry' and onto solid food, an adult ibis diet consisting of ground smelt, Toronto Zoo Small Carnivore Diet, chick chow, gelatin powder, vitamins, minerals and water. This was offered in addition to chopped pieces of whole eye smelt. The smelt was also supplemented with  $\frac{1}{4}$  tablet (25mg) of thiamine and 150 mg of Vitamin E.



African Sacred Ibis chick on Day 12



African Sacred Ibis chick on Day 14

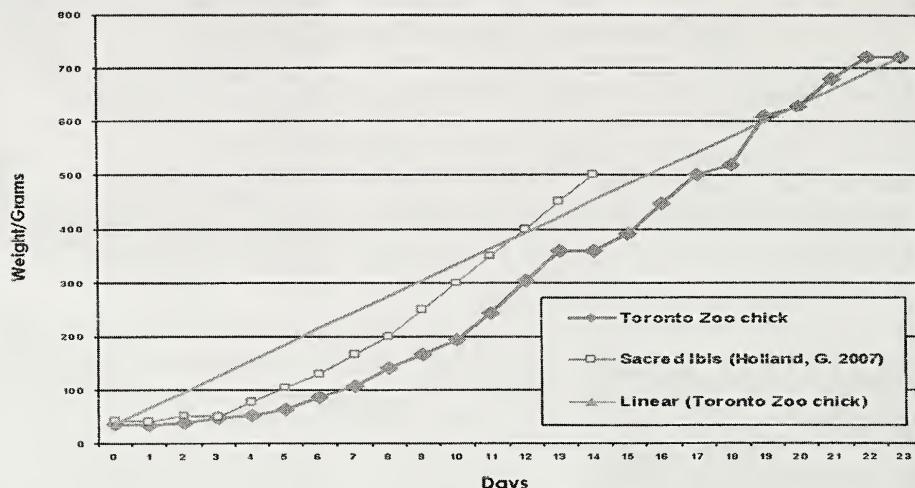
During the first month of hand-rearing, the Toronto Zoo chick's growth compared very closely to that reported in the literature (See Chart 1).



African Sacred Ibis chick on Day 21

## Chart 1

### Sacred Ibis Growth



### Weaning

The chick stayed in the brooder for another nine days while still being assist-fed. After that time (Day 23), it was moved to a pen in one of the Animal Health Centre holdings in the company of a single adult ibis that was being held there for medical treatment of a traumatic injury. The process of weaning it off hand feeding was then started. It still exhibited begging behaviour but was not competent in taking food items and swallowing them on its own. We were unsure how much of

the feeding behaviour is 'hard wired' versus learned in this species. Therefore we continued to assist-feed the chick but found it was not as content with this and began struggling when handled. If a smelt was placed part way down its throat it would usually swallow it but began more and more to either refuse or regurgitate.



Exercising chick's wings on Day 21

As the days progressed, the chick did begin to feed itself. On Day 33 the chick ate from the keepers hand on its own twice and on Day 42, the chick went without assist feeding for the first time and was observed eating the adult ibis mix on its own. Having a cage-mate present during feeding made a big difference as the chick slowly learned to feed itself through imitation.

From then on a new Sacred Ibis feeding protocol was developed. Food items offered were the adult ibis mix, chopped eye smelt, crickets and mealworms. When available we would also offer chopped pinkies and Toronto Zoo Small Carnivore Diet. The chick now weighed 910g [2lbs.] and we established a target weight of 1200g [2.64lbs.], the weight of its cage-mate. The young bird would be weighed first thing in the morning and at end of shift. Assist feeding would only be done at this stage if weight loss overnight was greater than 5% (~50 grams).



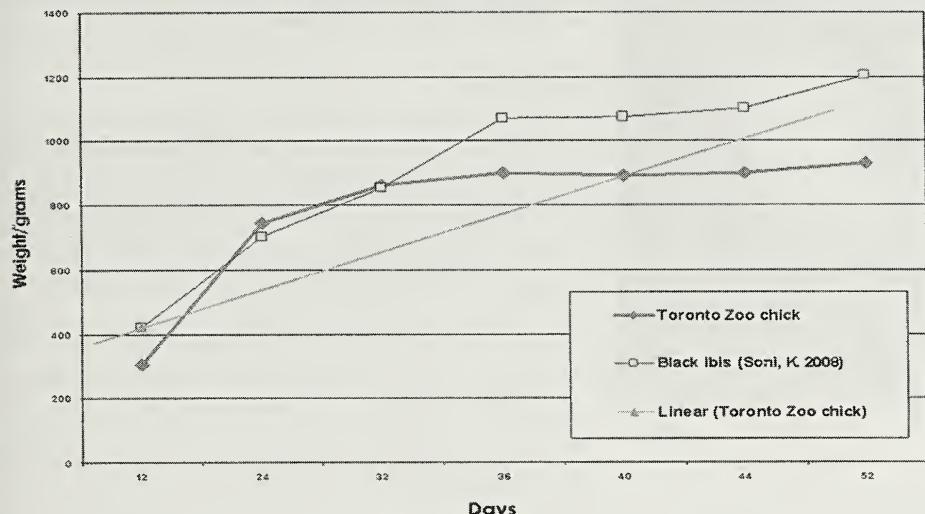
Chick at 32 days of age

The chick continued to gain weight under this new

protocol. Our chick's weight was compared to the weights for a similar species; the Black ibis /Red napped ibis (*Pseudibis papillosa*) and are presented in Chart 2 below.

**Chart 2**

**Growth comparison to parent-raised Black Ibis**



It is interesting to note in this chart that the data for our Sacred ibis chick shows a very similar plateau in growth approximately between Days 35 and 45 to that of the Black ibis.

The keepers were happy that the chick was eating increasingly more and more on its own, but were still concerned by its slow and lower growth rate during this stage and often felt it necessary to continue to assist-feed. We would usually assist-feed it fish at the end of the shift to allow it sustenance for the overnight period. However, as stated in Holland (2007), aviculturists caution overfeeding, which can result in too rapid growth, bowed legs and constipation.

Although up until Day 30, the Toronto Zoo chick was growing at a similar rate to that reported in the literature, the ensuing period of about one month was one of trial. We felt that it was very important that the chick learn to eat on its own, sooner rather than later. According to the literature it was already beyond the age at which it should have been weaned. It was thought that hunger could be a strong motivator but keepers were concerned that since we had failed to teach it to take food on its own during the early stages, it might suffer from lack of nutrition and slow growth during this period. We found that assist feeding the chick on occasion and offering it a mixture of food items was a good blend of strategies. Weights were recorded at the beginning and end of each shift to ascertain what balance of the two strategies was appropriate. Veterinary staff guidance was invaluable at this stage and the keepers, as is their nature, were committed to balancing objective reasoning with passionate care.

We found that by offering the Ibis mix and chopped smelt in a small amount of water with mealworms, crickets and chopped pinkies in an elevated bowl not easily reached by its cage mate worked best. It appeared that the chick was more inclined to roost and feed off the ground. We tried to monitor consumption and found that when it was offered this way the chick would eat up to 250g [~8.8oz.] of food, without assistance. The chick continued to be very intermittently assist-fed to maintain its



African Sacred Ibis Chick at  
37 days of age.

weight but since Day 73 the chick has been eating completely on its own. It now maintains a weight averaging around 1kg [2.2lbs.]. The next step for the keepers is to integrate it with the larger flock in order to socialize it for a possible departure to another institution in the future.

### Conclusions

We believe that we successfully hand-reared and weaned a healthy Sacred ibis chick from hatching, a first for the Toronto Zoo. The chick did develop slower according to data stated in the literature and does continue to weigh slightly less than the other adults in our collection. However, we feel that this has to do with the fact that our data is compared that of parent-raised chicks rather than hand-raised chicks. The supplemental assist feedings after weaning were only used as a means to maintain the chick's weight and overall health. Our real focus was on the development of its feeding behaviour and it was clear that having another bird around in lieu of a parent was a vital factor in our chick learning to eat on its own.

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## Feather Facts

Feathers allow the miracle of flight, and protect and insulate. In many species, feathers attract the opposite sex, and something about feathers might attract particular humans to a particular bird as well. For hundreds upon hundreds of years, the beauty of feathers have so appealed to humans, they have used them on clothing, hats, in their hair, dangled them from their ears, as well as used them for ceremonial purposes. Feathers evolved from the scales of reptiles and set birds apart from all other animals. Birds are the only animals that have feathers. Feathers are made of keratin, the same protein found in hair and nails. Although an adult bird will typically replace all of its feathers during a molt, the loss of feathers is staggered, often over several months, so the bird has enough feathers for flight and insulation. A molt is usually triggered by the change in day length or may occur after breeding.



Source: Doctors Foster and Smith, Pet Education.com and Holly Nash, DVM, MS

# Semen Collection on Rockhopper Penguins at the Indianapolis Zoo

By Tammy Root, Senior Aquarist, and Jenny Waldoch, DVM

Contributors: Karen Imboden, Orville VanDame, Jeanette Floss, DVM

Indianapolis Zoo, Indianapolis, IN

## **Why we began collecting?**

The Indianapolis Zoo's Rockhopper penguin (*Eudyptes crestatus*) population is aged and is not self-sustaining, which will lead to an empty exhibit within a few years. New captive animals are difficult to acquire and expensive because of the same lack of reproduction at other zoos. Wild collection of eggs is prohibitive due to declining populations, government import and quarantine regulations, and expense and time commitment of reaching remote breeding sites.

Because of the above position statement, we wanted to see if we could increase the number of eggs laid by artificially inseminating birds. The first logical step to begin the process is collecting viable semen. We also wanted to assure ourselves that our males were producing.

## **How did I train Rockhopper penguins for collection?**

Since this has never been done before on Rockhopper penguins, I had to gather my technique information from poultry. Not only was I able to find several pieces of information on the web, but I was also able to visit the poultry unit at Purdue University, West Lafayette, IN and practice semen collections on their poultry flock.

In order to start the training, I had to consider a couple of factors about the birds. For starters, I only trained the birds that were owned by Indianapolis Zoo. This allowed me to train 6.0.0, one of which was born in 1999 and the others were born in 1987. I also had to take into account that none of these birds were handled on a regular basis. Unless a medical issue appeared, the only time these birds were handled was once every three weeks for routine weighing. (However, all of our birds are hand-fed twice a day.)

The training process was developed in many steps. Below you will find the protocol that I used:

### **1. Training for collection presentation (milking)**

- a. Begin by acclimating bird to human touch
  - i. Throughout the day and during feeds, slowly approach male bird, pat the bird's stomach and reward with a capelin fish or a verbal "good job".
    1. If the bird eats outside of the feed, the number of fish eaten needs to be added to the daily total amount
    2. After the bird feels comfortable with the belly "pats", the keeper can then continue with belly "rubs" or massages. See Figure 1: Belly Pats
    3. After the bird feels comfortable with belly rubs, trainer begins massaging the vent area. See Figure 2: Vent Area Massaging with Bird Upright.
    4. All of the training steps are labeled in the training logs. Belly pats are BP; belly rubs are BR and vent area massages are VA.
  - b. Once the trainer feels that they can pick up the bird without too much of a fight, the trainer picks up the bird and brings the bird to the penguin sink counter. Ideally, you re-training the bird not only to be comfortable with one massaging the vent area, but also getting the bird comfortable standing on the sink. (A towel is placed on the stainless steel sink for bird's comfort). Trainer always rewards bird with a verbal "good job".

- i. The trainer picks up the bird with both hands holding the wings close to the bird's body.
  - ii. All of these birds have been picked up before for weigh-ins, so they should not get stressed out.
  - iii. If the bird becomes too stressed (the trainer's judgement is required), set the bird back down on exhibit and begin rubbing the bird's stomach.
  - iv. Trainer begins vent massaging the bird, increasing the length of time massaging is being done. (Bird is standing up)
  - v. Throughout the training, trainer should continually reward the bird with verbal sayings, all positive.
  - vi. If the bird becomes too stressed, try belly rubbing or belly patting the bird to try and calm him down. If this doesn't work, discontinue the session for that time.
- c. Finally, trainer should begin acclimating the bird to having him lay on his belly.
- i. This part of training should be done either on exhibit or on the sink counter.
  - ii. Trainer will need to restrain bird in this position by placing an arm over the backside of the bird. Restraint should continue as long as the bird feels comfortable.
  - iii. Next, trainer lifts bird's tail and using both hands, massages vent area in an inward/upward motion, gradually exposing the cloaca. See Figure 3: Stimulating for Collection.

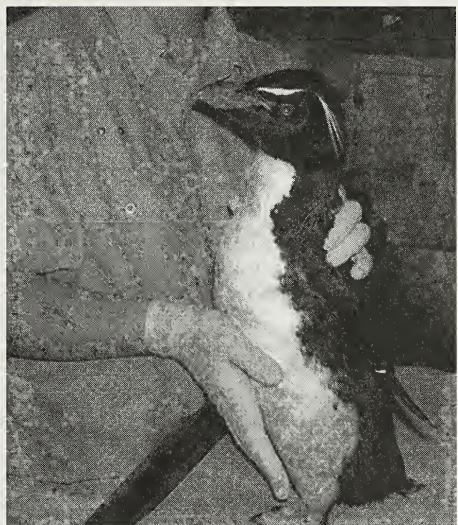
## 2. Training for Sample Collection

- a. Train bird for sample collection position as described above
  - i. Before collection is obtained, cloaca area should be cleaned with a dry towel or dry sterile gauze.
- b. Bring in second person, the "collector"
  - i. Trainer begins massaging and exposes the cloaca.
  - ii. Collector collects semen in a 1cc syringe. Trainer and collector collaborate on each bird to determine when to stop collecting. (dependent on behavior of bird, sample size, etc.)
  - iii. Bird is placed back into holding to calm down.
  - iv. Collected sample is then analyzed.
- c. Once the bird is trained for this, the whole positioning of the bird and collecting of the semen should only take 5-10 minutes (Zoo Biology 18:199-214 [1999]).

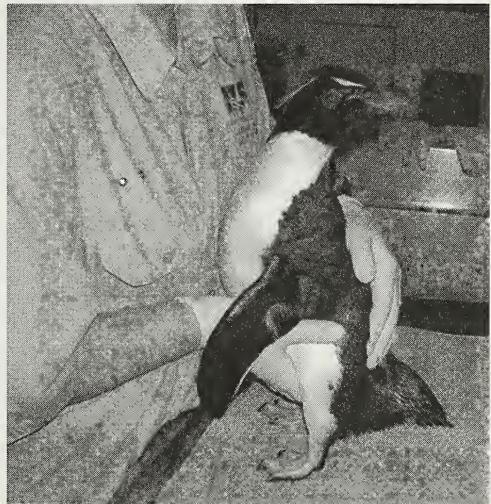
## 3. Rules of Training

- a. Diet, weights, stress levels, and training status were monitored throughout the breeding season by using an easy to read chart. The chart will include columns for bird ID#, time, weight, stage of training, total daily food intake and comments.
- b. Weights were taken weekly before the morning feed.
- c. Diet was recorded daily
- d. Training time, stress levels and training status was recorded after each session.
- e. Collection training was done with both non-breeding and breeding males.
- f. Rewards were always be food or positive vocal commands.
- g. If a bird becomes too stressed out during any stage of training, the training will stop and take a step backwards.
- h. "Collection" took place on the penguin sink counter. Due to the temperature difference from the sink to the exhibit, body temperature will be watched closely. If a bird becomes too warm, the session will end.

**Figure 1: Belly Pats**



**Figure 2: Vent Area Massaging with Bird Upright**



**Figure 3: Stimulating for Collection**

*(Photos by Tammy Root)*

The stars of the study were:

R113 with a date of birth of 18 Dec 1999  
R175 with a date of birth of 13 Dec 1987  
R191 with a date of birth of 14 Dec 1987  
R219 with a date of birth of 15 Dec 1987  
R221 with a date of birth of 15 Dec 1987  
R230 with a date of birth of 16 Dec 1987

### ***Were we successful in our collection attempts?***

We started collecting on 17 September 2004, a couple of weeks prior to breeding season. During this time, all of the birds were calm during each collection. We were able to collect a sample out of five birds. However, we ran into problems with temperatures of the microscope and the hot plate. Because of this, we were unsure of what the sample was. R113 did not give us a sample during this time.

The first week we collected semen with sperm was on 1 October 2004. We saw this from R221 and R230. On 7 October 2004, we placed river rocks on exhibit for nesting material to officially start breeding season.

On 15 October 2004, we collected again and were able to see sperm on five of the males. We didn't see sperm on R113, the youngest. By 28 October 2004, we were able to see sperm on all of the birds involved in the study. From this point forward, we collected weekly until we stopped seeing sperm from each bird two weeks in a row. We were able to collect semen with sperms from 2-9 weeks, depending on the bird. We were able to collect semen with sperm on R113 for two weeks and on R175 for nine weeks. We saw the last amount of sperm from one bird, R175, on 17 December 2004.

We successfully collected semen from all six birds in the study. Most of the collections occurred on Fridays at 1400 hours. During R175's last three collections, he milked himself. He seemed to get the signals as soon as he was picked up and set on the sink counter. He received all of the cues and knew exactly what to do!

Throughout the study each bird was monitored for their behavior, food consumptions and weight. Each bird exhibited normal penguin behavior.

In 2005, we added eight more male Rockhoppers to the study using the same techniques. During this time, we also conditioned nine females for artificial insemination. To condition for artificial insemination, we used the following techniques:

1. Place a towel on the penguin sink counter and duct tape it down. This will keep the bird from slipping.
2. Catch the female and hold her on the towel...allowing her to get used to staying on the counter. If the female becomes too aggressive or uncomfortable, release her back into holding or on exhibit until she calms down. If the female is comfortable and relaxed, reward with positive verbal commands.
3. Once the female becomes comfortable with #2, hold her belly down and expose the vent (same technique as conditioning for male semen collection as in above protocol).
  - a. Wipe vent area with dry sterile gauze
  - b. Gloves will be worn by both the collector and the trainer throughout the entire procedure.
4. After she feels comfortable with step #3, stroke under the vent area to encourage her to release any fecal material.
5. Add more pressure to the vent area to expose the moist pink fleshy internal region of the cloaca.
6. Insert the sperm, using a syringe, into the exposed cloaca and release.
7. Place the female back in holding or on exhibit after the procedure is complete.

## **Rules of Training**

1. Diet, weights, stress levels and training status will be monitored and recorded throughout the training process with an easy-to-read chart. Chart will include bird ID#, time, weight, stage of training, total daily food intake and comments.
2. Weights will be taken weekly only before breeding season. Once breeding season starts, weights will not be taken to eliminate some stress on the bird.
3. Diet will be recorded daily
4. Training will be done with both non-breeding and breeding females
5. Rewards will always be positive vocal commands.
6. If a bird becomes too stressed out during any stage of training, the training will stop and take a step backwards.
7. "Insemination and training" will take place on the penguin sink counter. Due to the temperature difference from the sink to the exhibit, body temperature will be watched closely. If a bird becomes too warm, the session will end.
8. **At no time will both the female and the male be off the nest.** There will always be somebody sitting on the nest.
9. Throughout the entire procedure, only non-contaminant sample will be used.
10. **If at any time during training and/or procedure the females seem to be losing their nesting behavior, we will stop artificially inseminating that female.**

When we added the females to the study, we would first collect from all of the males. After each sample was collected and evaluated for quality, the samples would be stored in a Styrofoam® box kept between 90-95°F [32.2-35°C]. After all of the collections were completed, the good samples would be pooled together and diluted with semen extender. This would ensure that all females would receive an equal amount inseminated.

In 2008, we extended our research to include five Gentoo Penguins (*Pygoscelis papua*) for semen collection. We added these birds to establish a baseline. We couldn't find any research that was being done regarding Gentoo penguin semen collection. For Gentoos we trained in the following manner:

1. Training for collection presentation (milking)
  - a. Begin by acclimating bird to human touch
    - i. Working with birds on landing
      - a. Condition birds to come to the top of the stairs
      - b. Acclimate birds to become comfortable in keepers' "laps" (bird on floor with head near keeper's body) for various lengths of time.
      - c. Acclimate birds to vent area back massages with tail lifted.
      - d. Acclimate birds to having cloaca squeezed for milk
  2. Training for Sample Collection
    - a. Collection is same as it is with Rockhoppers, but:
      - i. Collector will be down the stairs from the bird. It will be very difficult to lift the bird so that both the collector and the trainer can be on the same level.

Over the years, we have seen much cleaner samples with Gentoos than with Rockhoppers. We have learned that the Gentoos produce a lot of urates prior to collection. The Rockhoppers still tend to vary quite a bit in this respect. We are trying to perfect our massaging technique in hopes of getting cleaner samples.

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# Setting Up a Picture Perfect Success

By Katie Bagley and Christopher Watkinson, Keepers  
Bird Dept., Zoo Atlanta, Atlanta, GA

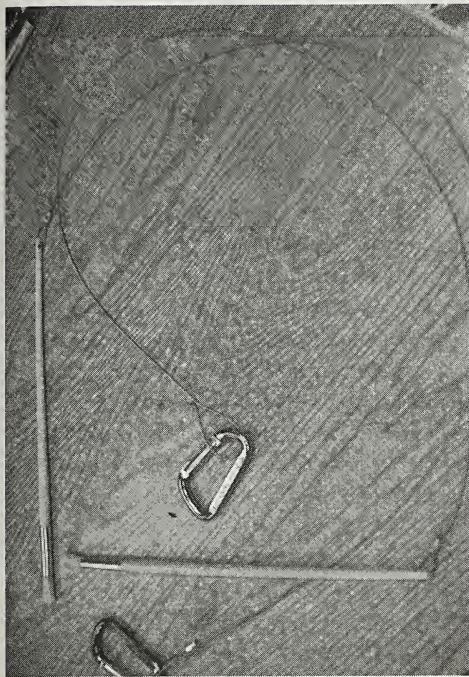
Zoo Atlanta's male and female Southern ground hornbills (*Bucorvus leadbeateri*) have made quite a name for themselves and are arguably the most popular birds in the zoo. Both birds are hand-raised and imprinted on people and therefore interact with the majority of guests who stop by their exhibit. Visitors will usually find Zazu and Gumby parading their food items in front of their plate-glass viewing window (to the dismay of the faint-of-heart) and at risk of being anthropomorphic, it appears as though the attention encourages them more. When the excitement of their food has worn off, these two birds will resort to banging their beaks on their window or other items in their exhibit to demonstrate more impressive displays. Our ground hornbills are crowd pleasers because they are very interactive and intelligent birds, but they also require a regular schedule of enrichment. Furthermore, Zazu (our female hornbill) tends to exhibit aggressive behaviors towards her keepers, which motivates us to provide her with activities that enable us to interact with her in a positive way.

Zoo Atlanta has a strong animal painting program that includes primates, program animals, elephants, and rhinos. The Bird Department felt that by training our two ground hornbills to paint, we would be able to provide them with an engaging form of enrichment. At the same time it would allow a positive keeper interaction for Zazu and provide zoo guests with a fun and educational experience. This experience has taught us many things in regards to training, and has increased our knowledge of these two birds as individuals. Our successes were often preceded by many failed attempts. It was Zazu and Gumby that showed us what they needed to be successful.

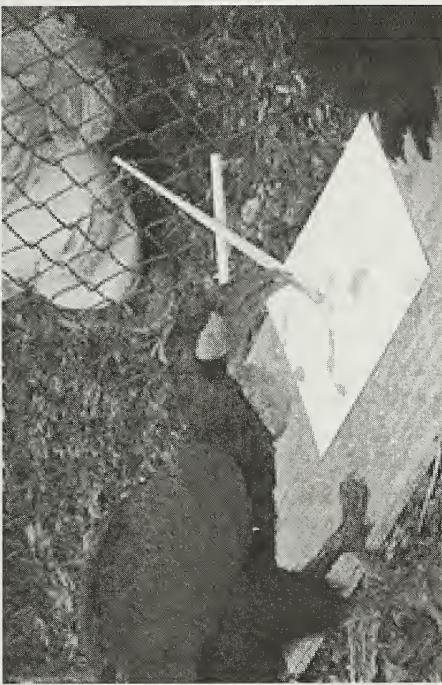
## Getting Started

We already knew that Zazu and Gumby liked wax worms and liked using their powerful beaks to manipulate objects. These two observations provided the building blocks for starting the painting behavior. We had seen Onyx, the Pied crow (*Corvus albus*) at Zoo Atlanta's wildlife theater, paint in demonstrations so we started with a similar set-up (with some minor adjustments) for our hornbills. Our ultimate training goal was to shift the hornbills inside their holding area (which they were already trained to do) while we set up their painting materials in their exhibit. We would then release them from their holding area into their exhibit so they could paint. Afterwards, we would shift them back into their holding area while we removed the painting materials. When we originally set up their painting materials we propped up two canvases that were attached to plywood boards against the perimeter fence of their exhibit. We provided two paint brushes that were modified so that the birds could not carry them off (though it would probably delight zoo guests if they did so). Cables were attached to the handles of brushes and the other end of the cable was connected to a carabineer (clip) that was then attached to the perimeter fence. We pre-dipped the brushes in paint for the hornbills.

The first time Zazu and Gumby encountered their painting materials they were immediately curious about the new items in their exhibit. They first tried to destroy the canvases with their beaks but they soon realized that they were rewarded with wax worms every time they touched the paintbrush with their beak. From this point we jackpotted them every time they held the paintbrush in their beaks and rewarded them even more when they shook the brush in a stroking motion. The birds had established the behavior of picking up the paint brushes within two training sessions. We initially attached the carabineer low on the fence allowing the brush to lay flat on the ground. While the hornbills could freely manipulate the brushes they were having a difficult time physically connecting the brush to the canvas. We believe this was due to the way the brushes were attached to the fence. It was apparent



Paintbrushes designed to attach to fence. (Photo: Katie Bagley)

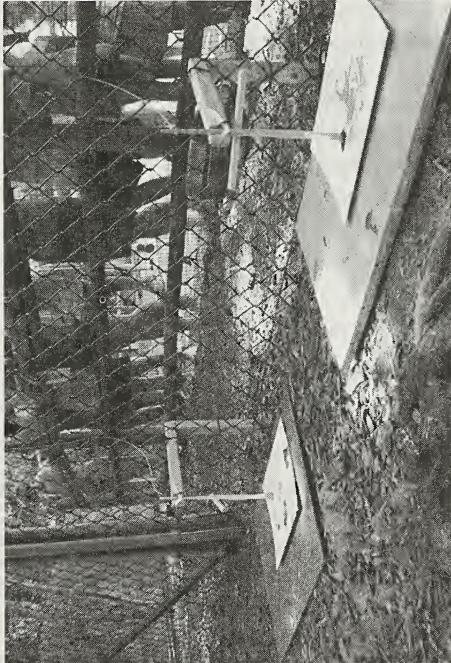


Gumby painting (Photo: Stephanie Scanlin)

G R O U N D      H O R N B I L L S      P A I N T I N G



Original painting set-up (Photo: Monica Holjin)



Painting set-up with training brackets (Photo: Katie Bagley)

that we had to change this set-up because Zazu and Gumby seemed to be getting frustrated and/or bored with the sessions since they would drop everything and go back to parading in front of guests. Since these birds were physically unique compared to other animals we had observed painting, we decided to use the behavior the hornbills had demonstrated in our training sessions to modify the painting set-up and to set them up for success.

### **Setting Up for Success**

Based on our earlier training sessions, we decided to set up their painting materials in a way that made it almost impossible for the birds to fail. We first attached the carabineers higher on the fence so that the brushes were upright and level with the canvases. When they were still failing to make contact with the brushes we placed the canvases flat on the ground instead of placing them upright. The brushes were making contact with the canvas when the hornbills dropped the brushes but they were not completing the desired behavior. Therefore, we designed what we jokingly referred to as “training wheels.” These were “L” shaped brackets made of scrap wood with a hole drilled out on one end. A paintbrush was then inserted upright into each bracket so that the brush end was in contact with the canvas. The hole in the bracket was large enough so that the hornbills could still make a stroking motion on the canvas with the brush. This set-up enabled the birds to simply manipulate the brushes slightly with their beak in order to make brush strokes.

Zazu and Gumby quickly learned that the more they moved the brush with their beak the more wax worms they received. We also believe that the paint colors were also enriching in themselves and we soon discovered that they had paint colors that they preferred (Gumby especially loved blue). While the hornbills became frustrated and would leave the previous set-up after lack of reinforcement, the new set-up that was designed for them as individuals proved to be successful in that they could perform the behavior when cued thus receiving food reinforcement often. We can’t help but think that the positive response from the crowd of guests watching was additional reinforcement for Zazu and Gumby. With a constant stream of reinforcement the birds remained at the painting stations until cued to shift inside their holding so we could take the canvases out of the exhibit. Sometimes the birds would continue to paint without food reinforcement during our failed attempts at trying to shift them while the crowd cheered them on.

### **Continuing to Make Progress**

Our current goal is to train the hornbills to make brush strokes without the use of their “training wheels.” To further help Zazu and Gumby be successful we have added a horizontal bar to the paintbrushes to give them multiple options in holding the paintbrush. Zazu seems to prefer the horizontal bar while Gumby still manipulates the actual brush. The hornbills are making contact with the canvases using the paintbrushes but they are still learning how to make brush strokes without the brackets. We are currently observing their behavior with the brushes so we can develop ways to help them be successful.

We may have taught Zazu and Gumby how to paint but these charismatic birds have encouraged us to look outside the box and analyze their individual needs. This idea can be applied to many behaviors and species. Furthermore, the birds now have an activity that is stimulating and enriching while zoo guests can watch their favorite Southern ground hornbills show off their talents. As keepers, we are enjoying interacting with Zazu without aggressive behaviors being exhibited towards us. This opportunity has opened many doors for us in regards to our avian training program and we continue to look for ways to set all of our birds up for success.

# **Supplemental Feedings to Aid a Parent-Reared African Pygmy-Falcon (*Polihierax semitorquatus*) Chick**

By Daniel Boritt, Biologist

Department of Ornithology

Smithsonian's National Zoological Park, Washington, DC

At the Smithsonian's National Zoological Park we have had recent success breeding African pygmy-falcons (*Polihierax semitorquatus*). While the population has seen a recent surge in hatchings, overall this population struggles to reach its target levels of reproduction. While many zoos have attempted to breed these birds in off-exhibit holding and hand-raise the chicks, we went an alternate route and bred the birds on exhibit with as little human interaction as possible.

Our sire is currently 14 years old, and was unsuccessful as a breeder until early 2008 when he was already 12+ years of age. In late 2006/early 2007 this bird was doing quite poorly and we worried about his well-being. Beginning with the death of his previous exhibit mate, he began to spend more time on the ground, and less time preening himself. His feather condition rapidly deteriorated as did his physical abilities to fly. While he has never been a strong flyer, he historically had been able to navigate his enclosure with ease, but as his condition deteriorated so did his ability to move around and he spent a fair amount of time off exhibit under veterinary care where he received calcium and vitamin injections.

In early 2007 a new piece of exhibit furniture was added to the enclosure. An 2.43m (8') tall pine tree with numerous horizontal branches was cut down and placed into the exhibit. The horizontal perches were trimmed to create something akin to a spiral staircase, allowing our male falcon to gain elevation through a series of short hops from branch to branch. This simple exhibit modification had immediate and drastic benefits for this bird. He soon began getting off the ground to higher elevations and his feather condition began to improve. While still somewhat lethargic and still not particularly active, the keeper staff began to gain an increased level of comfort with his condition.

In May of 2007 we received an eight-year-old female from the Franklin Park Zoo. This female, being hand-reared, had a very different disposition than did our parent-reared, older male. She was quite mobile and also quite bold, whereas the male was quite timid and would retreat from keeper staff upon their entering the enclosure. The new female on the other hand would eagerly approach keeper staff, and vocalize and head bob to solicit food. The birds were introduced in basement holding where we had more control over separating the birds, and within ten days were on exhibit in the male's previous enclosure.

With the addition of the female the older male's condition continued to improve. He became more attentive to his feathers, preening more often, and spent increasingly more time on the higher elevation perches, often perched next to the female. In June 2007 a naturalistic nest box was placed into the enclosure, mounted in the back right corner of the exhibit 173cm (5'8") off the ground, just below the highest horizontal perches on the aforementioned pine tree. The nest box is a 51cm (1'8") long piece of maple with a circumference of 41cm (1'4") at its thickest point. This log has been cut in half vertically and a nest chamber carved out, the cavity was left very rough so that a chick or parent could potentially gain purchase to aid in their exit from the nest. The log was then resealed and any gaps filled to ensure a secure nest log. The top of the log was then cut off, 10cm (4") from the top, and fitted with a top that could fit securely onto the log. The entire nest was supported by a steel Z-wall anchor drilled into the log, that slipped easily into a bracket mounted on the exhibit wall for seamless removal. The nest log was then filled first with Stalite® (lightweight aggregate) (<http://www.stalite.com/>) and the pine shavings up to a level approximately 8cm (3") from the nest cavity which has a diameter of 6.5cm (2.5"). A dowel was inserted into the nest log 5cm (2") below the nest cavity for easier entrance and the apparatus was mounted on the wall.

It did not take long for the falcons to begin exploring the nest log, with both male and female making frequent flights to the top of the dowel and eventually exploring the cavity. The hen laid her first pair of eggs in August of 2007, one being fertile but dying prior to hatching, while the second was infertile based on candling. The hen laid another single egg in October of the same year, but this egg too was infertile. In late November the pair began exploring the nest log and spending extended periods of time inside. By 21 December 2007 the falcons were spending extended periods of time inside of the nest log. At this point we began to limit our disturbances of the exhibit, only performing minimal cleaning, and entering only to feed the birds. By 29 December 2007 we were fairly confident the birds had laid eggs so we scheduled a nest inspection and on 4 January 2008 and discovered two

African pygmy-falcon eggs, one of which was determined to be fertile by candling.



Seven-day-old chick in naturalistic nestlog showing nestlog substrate.

(Photo: Dan Boritt)

the chick and weighed the bird, inspected the crop and proceeded to feed several segments of warm fuzzy with the aid of blunt tipped tweezers. The first several days we fed mainly organ meat, but made sure to offer all parts of the body to simulate a full prey item as closely as we could. On 18 January, Day 3, the chick weighed eight grams [0.28 oz.] (see Table 1). This procedure continued every morning by 0900hrs through the first 11 days. While we were feeding the bird daily, we never fed more than a single 2.5 grams of food, and our ultimate goal was to keep the chick hydrated, hoping the parents would do the feeding. As you can see by the growth chart (Figure 1), the feedings we offered were merely supplemental and the parents were feeding the bird well.

Daily weights and feedings supplemented with Pedialyte® continued through Day 12, at which point the chick had reached 28 grams [0.98 oz.]. From days 13-17 we continued to weigh the bird and if the bird had not gained three grams we would feed (this was only needed on Day 17, when the bird was only up in weight by two grams). Day 17, 1 February 2008, was also the last day of daily weights as we were now comfortable that the parents were performing an adequate job of nourishing the chick.

Although this female had successfully reproduced, due to parental neglect keepers at Franklin Park Zoo had been forced to hand-rear the birds in order to ensure survival. With this history of neglect in mind we formulated a protocol that would balance the chick's survival with our hopes of fledging a non-imprinted chick. With the aid of Karen Lisi in the Zoo's Nutrition Department we developed a diet as well as supplemental feedings of the chick to help keep the bird thriving through its early days.

On 17 January 2008 we confirmed the hatching of one chick that had hatched the day before, though we did not intervene until the following morning. On the morning of the 18 January 2008 we entered the exhibit with one fuzzy cut into 1mm segments, soaked in unflavored Pedialyte® (<http://pedialyte.com/default.aspx>), and warmed to approximately 36°C [98.6°F]. Wearing eye protection and long sleeves, two keepers removed the nest log from the wall and immobilized the hen by covering her with a hat to prevent her persistent attacks. We then removed



Eight-day-old chick weighed by keeper staff following supplemental feeding.

(Photo: Dan Boritt)

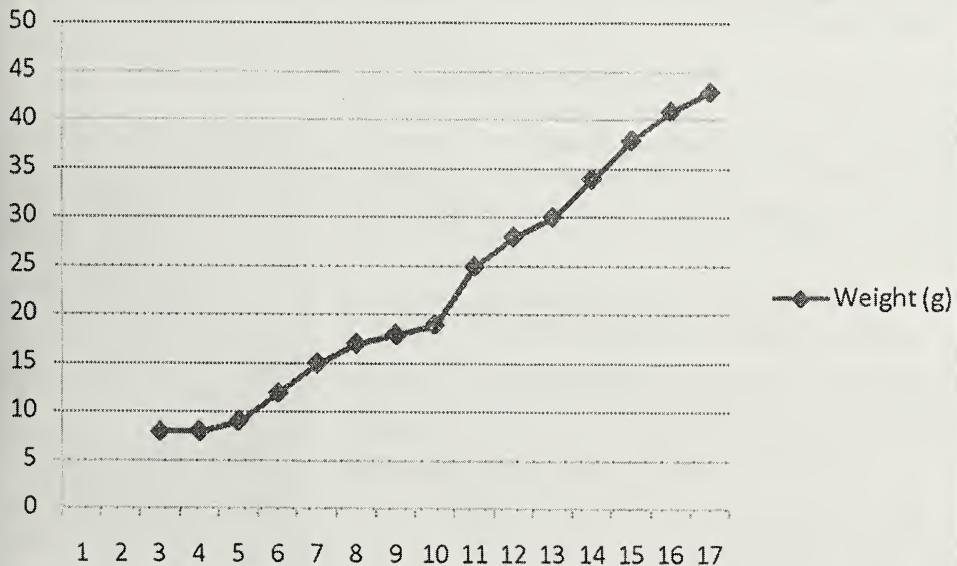
**Table 1**

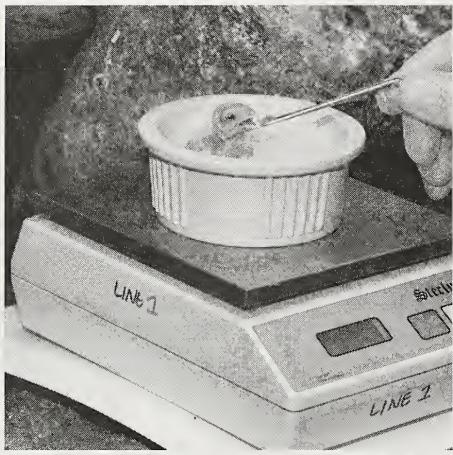
Day	Date	Weight [g]
1	16 - Jan	n/a
2	17 - Jan	n/a
3	18 - Jan	8
4	19 - Jan	8
5	20 - Jan	9
6	21 - Jan	12
7*	22 - Jan	15
8*	23 - Jan	17
9	24 - Jan	18
10*	25 - Jan	19
11	26 - Jan	25
12	27 - Jan	28
13	28 - Jan	30
14*	29 - Jan	34
15	30 - Jan	38
16	31 - Jan	41
17	1 - Feb	43

\* Picture taken on this date

**Figure 1**

### African Pygmy Falcon Growth Chart





10-day-old chick receiving supplemental feeding. (Photo: Meghan Murphy)



14-day-old chick following supplemental feeding. (Photo: Dan Boritt)

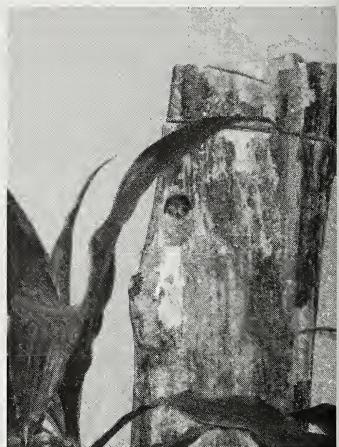


16-day-old chick receiving supplemental feeding on scale. (Photo: Meghan Murphy)

The falcon chick began to receive headless mealworms and legless crickets on 7 February 2008, Day 23 post-hatch. Observations continued regularly on the exhibit and food consumption (by means of displacement) was closely monitored with the goal of always have some portion of the diet remaining at the time of the next feeding (2x daily). On 11 February 2008, Day 27, the chick was again removed from the nest and weighed, tipping the scales at 63 grams (2.22 oz). On 14 February 2008, Day 30, the chick was observed peering out of the nest log for the first time. On 18 February 2008, Day 34, the chick finally fledged from the log, though

was soon back inside where it continued to spend the majority of its time until early March. The chick continued to live on exhibit with the parents until 27 June 2008, when we determined that parental aggression had reached a concerning level. The chick was removed and weighed 60 grams (2.12 oz), three grams (0.11 oz) less than our last recorded weight on 11 February 2008.

Over the next two years we had numerous clutches of eggs laid by the pair with limited fertility and survivability (all fertile eggs were early dead). We continued to occasionally offer the nest log but had little faith we'd get another chick due to the male's age and history of medical problems. However on 25 June 2009, we were yet again pleased to find one African pygmy-falcon chick in the very same nest log. The chick is still on exhibit with its parents and doing well.



25-day-old chick about to fledge peers tentatively out of nestlog. (Photo: Dan Boritt)

# Breeding White-crested Laughing Thrush (*Garrulax leucolophus*) at the Birmingham Zoo

By Alan Yester, Bird Keeper; Jeff Pribble, Zoological Manager of Birds;  
and Cindy Pinger, Curator of Birds, Birmingham Zoo, Birmingham, AL

## Introduction

The Birmingham Zoo has successfully raised White-crested Laughing Thrush (*Garrulax leucolophus*)s from 2006 through 2009, by both parent-rearing and hand-rearing. These active, vocal birds are a good exhibit species and a compatible pair will breed in a moderate sized exhibit with a basic, functional habitat. Mortality was high in both hand and parent reared chicks, 61% total. We identified two problems responsible in part for the chick mortalities that we were able to correct or treat. We experimented with three hand-rearing diets and had success with each. Parent-rearing was successful once the exhibit was rat proofed.

## Biology/Habits

The White-crested laughing thrush is native to the southern Himalayas and southeast region of Asia where it inhabits mountain forests, including bamboo stands. Males and females of the species are identical in size, 15-20cm (6-8 in.) tall, weight 112-120g [3.95-4.23 oz.], and in coloration, both sexes having a white underside and white crest, striking contrasts to the brown upper-side and black mask.

White-crested laughing thrushes are active, vocal birds making them an excellent exhibit species. Our individuals are not bothered by the public, remaining inquisitive even when being admired by a group of visitors. Birds spend almost as much time foraging on the ground as they do hopping from perch to perch. Laughing thrushes mutter and fuss while they go about their daily business, but these casual vocalizations are calm compared to their boisterous laughing. Males and females perform loud duets, which each sex singing a distinct part.

The diet of wild laughing thrushes includes insects and fruit items. The Birmingham Zoo diet is Apple Paradise® pellets with chopped fruit and vegetables, meat (about 5g/0.17 oz.) and mealworms. Crickets and wax worms are tossed into the exhibit in the afternoon.

## Exhibit Design

The Birmingham Zoo's laughing thrush exhibit is 3m x 2.4m x 3.7m (12 ft. x 8 ft. x 10 ft.). The upper half of the exhibit is currently covered with 1.37 cm (.5 in) hardware cloth. Three sides of the lower half are solid concrete. During the breeding seasons of 2006 through 2009 the bottom half of the exhibit front was glass, but has recently been replaced with mesh. The birds are cold tolerant and the mild Alabama winters allow us to keep the birds on exhibit year round with no indoor access. A heat lamp is provided in winter but is rarely used. An overhang in the back of the exhibit provides shelter from rain and a grove of bamboo in front of the exhibit provides shade in summer afternoons.

The exhibit is planted with two, seven-foot high evergreen trees which provide upper-story cover and nest sites. Dwarf evergreens and grasses provide ground cover. The exhibit floor is concrete covered with a thick layer of soil and a thin layer of hardwood mulch. Tree limbs provide natural looking perching and a small, shallow pool provides water for drinking and bathing.

We provide our pair with a ready made nest, a wicker basket with a 15cm (6 in.) diameter and a 10 to 15cm (4 -6 in.) cup depth. The bottom of the basket is thinly covered with hardwood mulch. Our birds never add much material to the nest, but do loosely line the bottom and sides with grasses and leaves they find in the exhibit. Nesting material, such as palm fibers, feathers and dry bamboo leaves

have been offered. Only the bamboo leaves have been used and these often fall into the exhibit on their own. The nest is placed in an evergreen tree 1.8 to 2.1m (6 ft. to 7 ft.) above the ground. In 2007, the male and his new mate started to build a nest with small sticks about a foot away from the nest basket located in the same spot the previous female had nested. The basket was moved to the spot they were building their nest and they immediately started using the basket.

The past breeding season our laughing thrush pair shared the exhibit with a pair of Bamboo Partridges (*Bambusicola fytchii fytchii*). There was no aggression between the adults, but the laughing thrushes killed all the partridge chicks that hatched on exhibit. We have never housed laughing thrushes with any other species.



Birmingham Zoo's  
Laughing Thrush Exhibit.

## Breeding Overview

### 2006-2009

The Birmingham Zoo has successfully bred White-crested laughing thrushes from 2006 through 2009, having raised nine chicks total, four hand-reared and five parent-reared. The same male has bred with two females. The breeding season in Alabama is March through August, with the earliest egg laid 23 March and the latest egg laid on 18 July. The first clutch is typically laid mid April to early May, with three to four clutches possible depending on success of early clutches and if chicks are pulled for

hand-rearing. Our laughing thrushes typically lay three to four eggs and no fewer than two. The parents share incubation duties beginning with the first egg, so chicks hatch asynchronously. As many as four chicks have hatched and once all four fledged, but we have never had more than two chicks in the same clutch survive. All the laughing thrush chicks at our zoo have fledged at seven to 12 days old and while they look like little laughing thrushes at this stage they are unable to fly. The chicks look and behave more like branchers than fledglings but the chicks consistently leave the nest at around 10 days. Even when the birds are placed back in the nest they soon hop out.

Our laughing thrush pair tolerates periodic nest checks. They fuss and scold, but always return to the nest or continue to feed chicks after the keeper has either visually peeked or gently felt into the nest. We avoid up close nest inspections starting eight days after the first chick hatches to avoid spooking the chicks into fledging earlier than they already do. We are usually able to count heads from outside the exhibit at this stage and do not need to be intrusive. The female, hand-raised, has attacked keepers but not during nest checks.

Monitoring nests is a helpful management tool, though may not be possible with every pair or in every exhibit depending on the nest location. Checking eggs and chicks every few days provides important information, such as how many eggs are laid and how many chicks hatch. Keepers use this information to recognize problems, whether in the egg (infertility, poor incubation etc.), or in the early stages of development (lack of food, environmental factors etc.)

## **The following is a breeding summary for our laughing thrushes.**

**2006:** Our original pair laid four clutches. The two chicks from the first clutch were found dead on the ground at Day 2, the second and third clutches fledged but were lost to rat predation. The fourth clutch hatched in late July, soon after which the female was found dead. The male raised two chicks by himself until they fledged at 12 days of age. One of the chicks was observed gasping and both were pulled for hand-rearing. The gasping chick died within 24 hours as the result of a wasp lodged deep in its throat, not discovered until the necropsy. Presumably the male tried to feed the wasp to the chick and it did not go down well.

**2007:** A new female was successfully introduced to our male in an off-exhibit holding area where they could first be “howdied” next to each other. Two eggs in the first clutch disappeared five days later. The second clutch produced four chicks. At Day 10 one chick was found dead on the ground partially eaten. The remaining three chicks were pulled for hand-rearing to avoid further predation. We successfully raised one chick from this clutch. The second clutch we planned on leaving with the parents, but pulled them after the female had to be removed due to aggression by the male.

**2008:** Two clutches were laid, the first in early June the second in mid-July. Two eggs from the first clutch were found in the pool, the third egg hatched and the chick was hand raised. The second clutch contained four eggs, one disappeared and three hatched. All three chicks fledged with two surviving.

**2009:** The first clutch, three eggs, was laid in early May. One egg was infertile, one egg disappeared and one chick hatched and survived. All four chicks from the second clutch fledged and two survived.

### **Hand-rearing**

The Birmingham Zoo has attempted to hand-raise nine chicks (none younger than five days) and successfully reared four (44%). The one chick died from the wasp, one chick was in a very weak condition when pulled and survived only half a day, one died within three days of unknown causes and the other three died from aspergillosis. The first three successes were the strongest of their respective clutches and the fourth was an only chick.

Chicks were raised in a 91cm x 51cm x 51cm (36 in. x 20 in. x 20 in.) wire cage with 5cm x 2cm (2 in. x 0.25 in.) gaps, with perches at various levels to make it easy for them to get around. The bottom of the cage was lined with newspaper. Two small doors allow keeper access for feeding and cleaning. All but one chick we pulled were feathered and did not need an external heat source, though we provided a heat lamp for one clutch because two of the chicks appeared weak.

We altered the chick diet each of the three years we hand raised laughing thrushes trying to find the diet that promoted proper chick development while being easy to prepare and feed to the chicks. The first year we were not expecting to pull the chicks. The two chicks were nine and 10 days old when we pulled them (wts. 46g and 45g / 1.62 oz. and 1.58 oz.) and had a good feeding response to tweezers, including the one with a wasp lodged in its throat (chick died the next day). We followed an hourly feeding schedule, from 0800 to 1700 hrs, until the surviving chick was weaned. We offered food until the chick stopped begging, feeding a combination of mealworms, crickets and soaked Apple Paradise® pellets (20% protein, 7 % fat) the first 11 days of hand-rearing. Wax worms, while digestible by adults, are not digestible by the chicks; even 14-day-old chicks passed whole wax worms. The pellets were soaked to provide liquid and were not offered at every feeding. We squished the heads on the insects before feeding them to chicks to prevent the insects from biting the birds as they were swallowed. At age 22 days we fed the chick pinkie mice cut into fourths. The chick readily accepted the pinky pieces and consumed 1 to 1.5 every hour. Our pinky supply was low so at Day 25 we returned to feeding crickets and mealworms. We started to wean the chick at 29

days, forcing her to grab the food instead of pushing the food into her mouth, feeding only what she took from the tweezers. The chick was eating out of a food bowl at 31 days and was entirely self-feeding at 32 days (wt. 70g/2.47 oz.), though she still begged for food.

In 2007 we pulled two broods of three chicks each for hand-rearing as soon as the chicks fledged. The first brood was pulled in late June, the chicks were about 7-10 days old (wts. 53g, 49g and 48g). We initially tweezer-fed them insects and soaked Apple Paradise® pellets which they readily accepted. During this period their weights decreased (43g, 41g and 39g). The smallest died on Day 4. A second chick died on Day 7 from aspergillosis. The fifth day of hand-rearing we changed to syringe feeding in addition to mealworms. We soaked Apple Paradise® pellets in water until all the liquid was absorbed then blended the pellets with additional water and a little calcium to make a “smoothie.” The remaining chick’s weight increased sufficiently after three days of syringe feedings that we returned to tweezer feeding mealworms and the regular adult diet of pellets and chopped fruits and vegetables with only one or two syringe feedings a day. The chick was self-feeding on mealworms at Day 24 and completely self-feeding at 27 days (wt 69g).



Recently Fledged Laughing Thrush Chick

The chicks from the second brood were also ages 7 to 10 days (wts. 50g, 44g and 39g) when pulled. The first three days we syringe fed each chick 1-3cc of soaked pellets every half hour hoping to avoid the weight decrease we had the time before; however, each chick lost weight. The smallest chick was weak and died the next day. A second chick died the following day; its weight was 39g. The third chick was back to 50g after four days of syringe feeding with 10-12 cc a day. At age 19 days we tweezer-fed its regular diet and the bird was self-feeding at age 27 days (wt. 75g).

We planned to let the parents rear all their chicks in 2008, but pulled the only chick from the first brood, hatched 17 June, after it was found on the ground beneath the nest at five days (wt. 28g). The chick was cold and was placed in a closed brooder box set at a temperature of 34°C (93°F). We used Kaytee Exact® hand feeding formula (22% protein, 9% fat), mixed according to directions, in place of the Apple Paradise® smoothie as an experiment. After initial feedings of 0.5 cc of formula every half hour, with additional water to increase hydration, we fed the chick 1.5 to 2.5cc formula every hour for the first day. The chick gained 4g, more than the target 10% weight gain. The second day we fed 2-4cc of formula every 1.5 hours. The third day, age seven days, we began feeding the chick pinky mice cut into thirds. The pinkies were warmed and sprinkled with calcium before feeding. At age nine days we moved the chick to an open brooder box with a heat lamp overhead keeping the temperature at 26°C (78 F) but found the chick to be most comfortable at 24°C (75°F). From age 10 to age 18 days we fed half pinkies every one to one and a half hours, as many eight pieces (four whole) per feeding then switched to tweezer-feeding insects, pellets and fruit/vegetable mix from the food bowl that was left in the cage during the day. The chick was self-feeding at Day 25 (wt. 81g).

### Evaluation of Hand-rearing Methods

We successfully hand-raised chicks with each of the three chick diets: insects and pellets, insects and liquefied pellets and liquid formula and pinkies. A diet of insects and dry pellets worked well, but feeding small food items by tweezers can be time consuming. Syringe feeding takes less time and provides hydration. Chicks responded well to the syringe and would “swallow” the syringe, speeding up feeding time and reducing the risk of getting food in the trachea. Syringe feeding is especially easier than tweezer-feeding when feeding weak chicks. The pinkies were also quick to

feed. Weight gain was not significantly better on pinkies and the biggest weight gain occurred after the switch to insects, but the sample size is much too small to say this is significant or even typical.

Pinkies are expensive and may be cost prohibitive. Mealworms and crickets can also be expensive and at times are in short supply. A combination of liquefied pellets or a powder chick formula in combination with insects is perhaps the best diet. Less time is spent feeding the chicks, assures proper hydration and is less expensive. Age, weight and overall condition of the chicks at the time they are pulled should be taken into consideration when determining what to feed the chicks. Week-old chicks should handle pinkies well (Mace, 2007). Laughing thrush chicks can be weaned by 27 days regardless of the rearing diet.

### **Concerns**

Aspergillosis was a problem each time we hand-reared chicks. Three chicks died from aspergillosis and three other chicks were successfully treated. The survivors were treated with Itraconazole administered orally and nebulized, every day for a week with a mixture of Enrofloxacin, Itraconazole and Amphotericin B. We have successfully raised flamingos, pigeons, lorikeets, ducks and quail in the same room we reared our laughing thrushes in, and only had a couple of aspergillosis cases in those species.

Imprinting is a possibility and could be a problem. The first laughing thrush we hand raised is severely imprinted, becoming active and vocal at a mere glimpse of a keeper and aggressively attacking certain keepers. She is housed with a hand-raised male who is not as heavily imprinted. This pair has not attempted to breed. The other three chicks we hand raised did not appear to be as imprinted as the first, but we did not keep them longer than eight months so we do not know their long term behavior. We tried to keep talking to a minimum around the chicks and handled them only when necessary. Hand-raised birds will breed. Our current breeding female was hand raised by another institution and behaves in relatively the same manner as the bird we raised, being very responsive to keepers. She has attacked keepers, but not frequently. Her mate is parent-reared and was already a proven breeder.

### **Parent Rearing**

Our White-crested laughing thrush have had the opportunity to rear 14 chicks to completion (including the four predicated), five survived. The first two breeding seasons, 2006 and 2007, we provided the parents with freshly molted (white) mealworms, ones whose skin had not hardened. Freshly molted worms were offered to avoid impaction as the chitin skins may be hard for chicks to digest. When we could not get enough freshly mottled worms we offered crickets with the hind legs removed. After seven days we started offering regular mealworms and crickets. Parents are meticulous about masticating the heads of the crickets and mealworms before filling their beaks with the insects and flying to the nest one at a time. The parents always feed the chicks before they feed themselves. We provided insects, placed in a bowl on the ground, every two hours. We keep the exhibit pool drained once chicks are in the nest to avoid fledglings drowning and provide water in a shallow pan. All the chicks that fledged in this time period were pulled for hand-rearing.

Beginning in 2008, we started keeping a constant supply of mealworms available to the parents, regardless of molted or not. We thought the chicks might be fledging early because the lack of food. While compaction from mealworms may be possible, we decided poor condition from lack of food was a greater risk. We never had any problems with chicks digesting mealworms. Even with the increased supply of mealworms no more than two chicks per brood survived and chicks still fledged at about 10 days of age. We did not weigh parent-raised chicks until they were pulled from the exhibit so we have no comparison to hand raised weights. Parent-reared chicks were weaned at about five weeks, a week longer than we were able to wean chicks during hand-rearing.

Three chicks of the second 2008 clutch fledged and two were successfully parent-reared, the first

time for our zoo. In 2009 one chick hatched in late May and survived. We placed the bowl of worms on a small elevated platform the bamboo partridges were unable to access, otherwise the partridges were apt to eat many of the worms. A second clutch was laid 20 days after the first chick hatched. All four eggs from this clutch hatched. One chick was found dead below the nest nine days after hatching. The other three chicks were all fledged four days later. Unlike other broods that all fledged on the same day, one chick stayed in the nest a full day longer than its two siblings.

The smallest chick was found dead two days after fledging. The other two survived.



Adult Laughing Thrush Feeding Chick

Helpers, offspring that help raise younger siblings, have been observed in White-throated Laughing Thrushes (*Garrulax albogularis*) and Yellow-throated Laughing Thrushes (*Garrulax galbanus*) (Mace, 2007). The chick from the first clutch was not observed feeding the younger siblings as he was only recently self-feeding and would still food beg (occasionally getting fed) while the second brood was being cared for. All three chicks were left in the exhibit with the parents until the end of August. No further nesting was attempted.

### Evaluation of Parent Rearing

Parent-rearing went well once the predation problem was fixed, with 63% of all hatchlings successfully raised. Keeping a constant supply of worms available is recommended, but all the chicks may still not survive. Asynchronous hatching may be a cause of the high chick mortality. Keepers observed the parents feeding all chicks in a given brood but as happens in the wild the strongest, usually the oldest, may get the most food, even when there is no food shortage. A survey of captive Blue-crowned Laughing Thrush (*Dryonastes courtoisii*) showed a chick mortality of 79.8% (Edmans, 2008).

### Concerns

Our primary obstacle to successful parent-rearing was chick predation by rats. The first two years we were unable to keep chicks with the parents past fledging, their inability to fly and their habit of sleeping on the ground or low to the ground made them vulnerable to rats. At that time the exhibit was covered with 2.5 cm x 5 cm (1 in x 2 in) wire mesh which rats were able to squeeze through. Switching to 1.3 cm (0.5 in) hardware cloth solved the problem.

Post-nesting aggression occurred twice. The male became aggressive toward his mate during August 2007 and 2008 soon after the last brood of the year fledged. The current female does not feed the chicks as much after they fledge, though she is very attentive when they are in the nest. If the female goes back on the nest there is no aggression, only after the last brood has fledged does the male become aggressive towards her. The female suffered severe trauma to the back of the neck in 2007 and required stitches. The pair was kept separated until February of 2008. The female was pulled as soon as aggression was observed in August 2008. We put the pair back together one month later without further incident. The aggression may be due to 1) The male wants the female to return to the nest or 2) The male takes exception to the female ignoring the chicks after they fledge. We suspect the first. There was no aggression in 2009, perhaps because two clutches were successful. We have observed this aggressive behavior in our Victoria-crowned Pigeon (*Goura Victoria*) pair. We pull the female soon after the chick fledge and the male raises the chick alone.

We had a problem in 2009 with the Bamboo partridges roosting in the Laughing thrush nest. The

evergreen tree the nest was in was compact enough that we were able to pull branches in tight around and over the nest leaving an opening large enough for the laughing thrushes to enter but not the partridges. The partridges did not interfere with the laughing thrush breeding, but as stated earlier the laughing thrushes did kill all the partridge hatchlings.

### Conclusion

White-crested laughing thrushes are a low maintenance species suitable for breeding on exhibit. Hand-rearing was essential during the first years of breeding, but now that the predation problem has been solved we will let the parents raise their own chicks from here on out unless unforeseen circumstances deem otherwise. Chick mortality may be high even under the best of circumstances, but providing a secure and comfortable habitat and monitoring behavior and nest activity will ensure a fair amount of success breeding these birds.

### Products Mentioned in the Text

Apple Paradise®, manufactured for Marion Zoological by Scenic Bird Food, [scenicbirdfood.com](http://scenicbirdfood.com),  
2003 E Center Circle, Plymouth, MN 55441, USA.

Kaytee Exact®, manufactured by Kaytee Products, Inc., Chilton, WI 53014, USA.

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### Photo Credits

All photos taken by Lydia Cost, Registrar at the Birmingham Zoo.

## Types of Feathers



Contour Feather



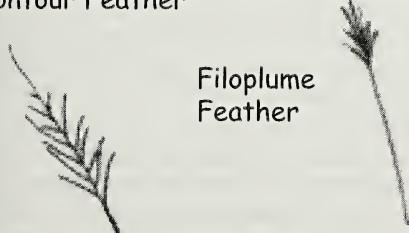
Down Feather



Flight Feather



Semiplume Feather



Filoplume Feather

Bristle Feather

Do you know the functions of each feather? If not, look for the answers elsewhere in this issue of AKF. (*Drawings by Jody Hildreth at [www.kidwings.com](http://www.kidwings.com)*)

# The Management and Breeding Program of Roseate Spoonbills at the Palm Beach Zoo at Dreher Park

By Megan Derousie, Avian and Carnivore Keeper III  
Palm Beach Zoo at Dreher Park, West Palm Beach, FL

The Roseate Spoonbill (*Ajaia ajaja*) is a large wading bird. It is pink in color with a long, distinguishable flat bill. This dashing bird can measure up to 2.5 ft. [0.76m] and has a wingspan of 4 ft. [1.21m]. Adult Roseate spoonbills have bald heads with a greenish tinge skin color and a black band going across the back of the head. The neck and upper back feathers are white while the rest of the body's feathers are pink in color. They also have a large, darker pink stripe across their wings. As juveniles, the birds are a paler pink color and their heads are covered in white feathers.

The range of the Roseate spoonbill includes coastal Texas, southwestern Louisiana, and southern Florida. Additionally, they can also be found through the Greater Antilles down to Argentina and Chile. They will inhabit both fresh and saltwater marshes, lakes, swamps, and rivers. Due to their habitat, Roseate spoonbills feed on a varied diet consisting of small fish, amphibians, invertebrates, and some plant material. These wading birds will stand in the shallow waters and swing their bills back and forth searching for food items. Once they find their food, they will grasp it with their bill and swallow it whole.



Wild Ibis and Spoonbills (Photo: Keith Lovett)

Roseate spoonbills are typically not sexually mature until three years of age. Their courtship behavior consists of bill clapping, head bobbing and dancing, and the exchange of nesting material. Once a pair is formed, the female will build the nest while the male searches and brings the nesting material to her. They will nest in mixed colonies with other species such as herons, gulls, wood storks, and ibises. A female will lay three to four pale cream-colored eggs, and both parents will take turns incubating the eggs for 22-24 days. The chicks are born with white down feathers and a very small spoon-shaped bill. Both parents share responsibilities for caring and feeding the chicks. The chicks will bob their heads and vocalize to let the parents know they are hungry. The parents will then regurgitate food into their mouths until the chicks fledge the nest, and then slowly the parents will teach them how to feed on their own.

At the start of the 1900s, a decline in the Roseate spoonbill population began due to hunting and the demand for the pink primary feathers for ladies' fans. As a result, the Roseate spoonbill were protected by the Migratory Bird Treaty Act of 1918. However, the species continued to decline, and in the 1930s hit an all-time low with only 30-40 breeding pairs found in remote areas of Florida. The population in Florida has now increased to over a 1000 breeding pairs. The populations in Texas and Louisiana, however, are still vulnerable due to development in their breeding locations. Roseate spoonbills are now considered a Species of Special Concern in the U.S.

AZA-accredited zoos that house Roseate spoonbills take part in the Population Management Plan (PMP®) for this species. The plan's purpose is to manage and conserve the population by getting zoos and aquariums to voluntarily manage their animals in accordance with the recommendations made by the PMP® manager. Each institution is responsible for maintaining a healthy, genetically-varied, and demographically assorted population. With these standards, it is important for each facility to keep

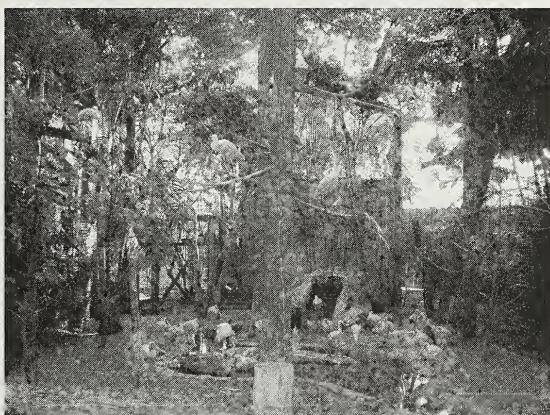
excellent records on the birds' breeding and nesting behaviors to share with other facilities housing this species. This can ensure a varied population among zoos and aquariums that take part in the PMP®.

The government is also involved in protecting Roseate spoonbills. The Coastal Restoration Program aims to determine the most critical human and natural ecological needs of the coastal area. Restoring coastal areas benefits Roseate spoonbills by providing them with appropriate habitats. The Everglades Restoration Plan was put into action to restore a majority of the fresh water supply that is needed in certain areas. The hope is that this will help improve the environment and ecosystem of those areas. With this in effect, spoonbill breeding locations can be protected and the population will have the opportunity to continue to grow.

In 2001 the Palm Beach Zoo at Dreher Park received 2.2.2 Roseate spoonbills from the Fort Worth Zoo. When these birds first arrived, they were held off-display in a holding area for quarantine. In 2002, the zoo received 1.1 spoonbills from the Oklahoma City Zoo and an additional 2.2 individuals from the Fort Worth Zoo. While the 2001 group of Roseate spoonbills was still being housed off-display, they were offered nesting material. There was not any nest building seen or recorded for this group at that time. After the 2002 group of Roseate spoonbills was introduced into the first group and the entire group was placed on display, they started showing signs of nest building in early August of the same year. By the end of the month, breeding behavior was observed and females finally started laying eggs.

At the end of August 2002, the group had its first cohort of chicks hatch out in one nest. The nest had three hatchings but only two survived. The month of September 2002 produced three more successful hatchings. The Palm Beach Zoo's group continued to produce eggs and successfully fledged a number of birds the following year in the months of February, March, and June. A majority of the juveniles were sent out to other zoos for breeding programs, although some were kept in the group to maintain our group's health and genetic diversity.

The Palm Beach Zoo at Dreher Park houses our collection of Roseate spoonbills in an exhibit that is around 15 ft. high x 15 ft. wide [4.57m x 4.57m]. We use wire mesh to cover the exhibit. The birds have mayho trees, areca plants, artificial trees, and wooden meshed platforms on which to perch and nest. Much of the nesting is done high up in the mayho trees with multiple birds nesting around each tree. The exhibit also contains a small waterfall leading into a stream where the birds bathe, drink, feed, and wade. This stream is cleaned out twice daily due to the amount of feces and urates all the birds produce each day. We also use fine white sand that is easy on the birds' feet, is easy to clean, and is aesthetically pleasing for our visitors. Our collection of Roseate spoonbills are also housed with Scarlet Ibis (*Eudocimus ruber*) and Sacred ibis (*Threskiornis aethiopicus*). A total of 45 birds are currently housed together in the exhibit. The birds have never shown serious aggression in this exhibit. Occasionally, when spoonbills and ibis chicks fledge the nest, you will see some of the adults from both species mount the chicks. It is almost as if the adults are showing their dominance over the chicks. It is great having the species together for visitor viewing and observing the species displaying natural behaviors. Zoo visitors enjoy seeing both species to compare their vibrant colors, and it is also a great way to educate visitors that in the wild all different species of water birds will naturally nest together.



Spoonbill Exhibit at the Palm Beach Zoo

(Photo: Megan Derousie)

The daily morning staple diet that is fed out to our birds is Mazuri® Brand Flamingo Breeder and Flamingo Powder. This brand of food mimics the bird's wild diet by providing certain levels of vitamin and fish proteins and contains certain pigment to help keep their feathers bright in color. As a supplement to their diet, they are also given Nebraska® Brand Bird of Prey meat which is scattered around the exhibit for enrichment or placed in their morning diet. In the evening, they are given silverside fish in multiple pans placed around the exhibit. They are given supplements such as vitamin B, thiamine E paste, and roxanthene to enhance their color even more. Meal worms and crickets are also added for enrichment.

The breeding season seen at our zoo will typically start in January and end in March. After a short break, the breeding resumes in July and continues until the end of September. During the breeding season we offer the birds a variety of nesting material daily. We give them bamboo, vines, ficus, and varied leafy and flexible sticks found around the zoo. The sticks the birds tend to prefer are the ficus and vines, or anything that is leafy and flexible enough to be manipulated into the nest. The birds exhibit behaviors seen in the wild as the female will stand and wait to build the nest while the male searches and brings her the material. This is why it is important to provide them daily with varied sticks since the female will occasionally drop the sticks the male gives her when she is unsatisfied with the selection. They will also steal sticks from other nests and destroy their own nest if they are not satisfied with the nesting material.

Right before the breeding season you will see a lot of head bobbing, dancing, bill sparring, and the exchanging of sticks between paired individuals. The male will do most of this behavior to impress the female. Observers will also hear a lot of vocalization within the group. The adult male and female in a breeding pair will fly back and forth to the nest and will be seen copulating in the nest once it is completed. Once the first egg is laid, this behavior does stop. The same pair continues this courtship behavior throughout the year and will usually pair again the following year and repeat the cycle.

The Palm Beach Zoo at Dreher Park's breeding program consists of three to four pairs each year. They will usually clutch out two times a year. If they start early in the season, or their first clutch is unsuccessful, they will have three clutches. They will lay three to four eggs per nest. At times they will push an egg out, or an egg will accidentally fall out of the nest. In that case, they will then lay another egg before incubating the clutch.

We are very hands-off when it comes to incubating an egg. The parents are very good incubators, which means we have never had to resort to artificial incubation. The female will most often be seen incubating the eggs. She will get off the nest very briefly to eat, and then the male will take over the duty of incubating the egg. If either parent sees any disturbance around the nest, both parents fly over to sit and protect the eggs.

Both parents are excellent at guarding the chicks from other birds and keepers. The birds tend to nest very close to each other, so you will see the parents doing a great deal of bill sparring with each other when one steps over the line and gets too close. When the keepers are checking nests, a portable security mirror will be used, and the parents immediately fly over to the nest and cover the chicks and spar with the mirror. This can make it hard to monitor the chicks, so keepers will stand and listen to make sure they are still hearing the chicks vocalize, showing us they are still strong. Once the chicks are fully standing in the nest, it is a lot easier to monitor them from a distance.

The Roseate spoonbills are very good at caring for their young. When the chicks first hatch they have a very quiet feeding vocalization. Once the chicks are strong enough, they will start standing, head bobbing, and will break into a loud burst of feeding vocalization toward the parents every time they are hungry or the parents fly over to the nest. After about a month, the chicks will begin exploring around the nest while the parents continue to feed them. At around a month and a half of age, the chicks are flying back and forth from one nest to another, while staying very close to the original nest since the parents are still feeding them. After two months, the chicks will be down on the ground exploring, but



Spoonbill parents protecting chicks. (Photo: Keith Lovett)

great job, zoo staff prefer not to interfere too much. The one major problem we have encountered is the eggs or chicks falling out of the nest. The zoo has developed a very successful solution by placing a mesh-type material under all the nests. During nesting season the keepers will check the nests first thing in the morning to see if anything has fallen out. If an egg or chick is found, it will be placed back into the nest. Fortunately the parents have always accepted the egg or chick back into the nest without any issues. The mesh cushions the egg from cracking when it falls and saves the chick from drowning in the stream or being injured by the fall. During the summer months, an increased issue with chicks who are still in the nests are signs of heat stress. To remedy this, a large tarp is placed onto the top of the exhibit to give the chicks and nests more shade. By closely monitoring the behaviors of the chicks and our surrounding environment, we have been able to solve these issues.



Spoonbill chicks in nest. (Photo: Keith Lovett)

will still return to the nest at night. The chicks will continue to beg for food, and although the parents will begin to ignore them more and more, they will still give them an occasional feeding. The more the parents ignore the chicks, the sooner the chicks catch on and attempt to eat on their own at the group feeders. In the beginning, the chicks are very hesitant due to the occasional shoving from the other birds, but once the chicks know the pecking order, they become more independent when eating with the group.

The zoo's role in protecting the eggs and offspring is relatively hands-off. Since the parents do a

Zoo staff continue to learn about the Roseate spoonbills' breeding behavior with daily observations, which has led us to have a very successful breeding program over the past couple of years. The zoo has had spoonbills on exhibit for close to eight years and every year they have successfully raised offspring. In addition, the number of chicks has increased each year. Two-thousand-nine was our most successful year with eight chicks successfully fledging the nest. With the knowledge we have gained, the spoonbills' breeding success rate will hopefully continue to increase.

With our proven and continued success we are able to send out healthy, genetically-varied breeding pairs or singletons to other zoos and aquariums around the country. Varying the breeding line can help to ensure a healthy captive population both at our zoo and at other institutions that house this

vibrant and unique wading bird. With a continued growth in the Roseate spoonbill breeding program in zoos and aquariums, and assistance with the protection of wild population breeding locations from the government, there is hope that the species will continue to make a comeback.

The Palm Beach Zoo at Dreher Park knows the importance of educating visitors about these beautiful birds not only in the wild, but also in captivity. It is our mission to promote field projects, educate the public, and provide funding for research and reintroductions back into the wild if and when appropriate.

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## Types of Feathers.....Did You Know?

Feathers come in many different shapes, but all of them can be classified into six different types of feathers. The feathers we are used to seeing are flight and contour. Down feathers are what we use in pillows, quilts, and jackets. The other three feathers, semiplume, filoplume, and bristle, are not as common, but still useful to birds.

1. **Flight** feathers are found two places on birds: the wings and tail. Flight feathers are long, and on the wings, have one side of the vane wider than the other. They also have stronger barbules which give them more strength for flight.
2. **Contour** feathers give shape and color to the bird. They are found everywhere except the beak, legs, and feet. Contour feathers are colored only at the ends (the only part that we see). At its base, a contour feather becomes downy which helps insulate the bird.
3. **Down** feathers have little or no shaft. They are soft and fluffy. Down feathers help insulate birds by trapping air. Some birds, such as herons, have special down feathers called powder down which breaks up into a fine powder. The bird then spreads this fine powder all over its body to act as a water repellent.
4. **Semiplume** feathers are a cross between down and contour feathers. Unlike down, they do have a well formed shaft. However, they do not have well developed barbicels which make them soft. Semiplume feathers are found underneath contour feathers and are used for insulation.
5. **Bristle** feathers are very stiff with only a few barbs found at the base. Bristle feathers are found around the mouth of insect eating birds where they act as a funnel. They can also be found around the eyes where they work like eyelashes.
6. **Filoplume** feathers are incredibly small. They have a tuft of barbs at the end of the shaft. Unlike other feathers which are attached to muscle for movement, filoplume feathers are attached to nerve endings. These feathers send messages to the brain that give information about the placement of feathers for flight, insulation, and preening.

(Written by Jody Hildreth at [www.kidwings.com](http://www.kidwings.com))

# Puppets: Construction and Use for the Hand-rearing of Birds

By Giane Giuffre, Assistant Keeper; Bob Thornton, Assistant Lead Keeper;  
and Colleen Lynch, Curator  
Lincoln Park Zoo, Chicago, IL

## Introduction

Successfully rearing chicks is always a challenge. While parent-rearing is the desired method of chick rearing in most instances, it is sometimes necessary to artificially rear birds due to a variety of factors: death of an incubating or brooding parent, egg destruction, poor parental care of chicks, risk of disease transmission from parents to chicks, threat from aggressive exhibit mates, competition or siblicide from clutch mates, etc. If a species is in peril, artificially rearing chicks is often the recommended method to increase the number of clutches produced per season as well as to ensure chick survival against any of the risks listed above.

Artificial rearing can be done in several ways. Puppet-rearing may be the most effective artificial method in use to avoid inappropriate imprinting of chicks on their keepers. With careful elimination of any chick-human interaction and appropriate visual cues of an adult conspecific, a puppet provides some of the basic stimuli a juvenile bird focuses on when housed with and cared for by live conspecifics. Though species-specific results vary and parent-rearing is most often the preferred method, puppet-rearing gives us an alternative that may be beneficial to a bird's ability to live socially with conspecifics and achieve reproductive success.

The natural history of the species in your care, their degree of sociality and a similar comparison between parent-reared and artificially-reared birds may provide guidelines necessary for choosing the method to artificially rear birds (Wallace, 1994). Not all situations allow for careful comparisons between parent- and puppet-reared chicks, and in many cases the benefit is assumed based on studies like the ones referenced below. Puppet-rearing may be most useful in species having a smaller clutch size, that naturally leads to more parental dedication to individual young, and a higher degree of sociality. Puppet-rearing may be considered of great importance especially in cases where individuals are reared for reintroduction programs. In these instances, rearing method may not only influence future reproductive success but also the ability of the released individual to survive in the wild (Wallace, 1994). The Andean (*Vultur gryphus*) and California condors (*Gymnogyps californianus*) illustrated little behavioral difference or change in success rate between released condors that were parent-reared or puppet-reared. Bald eagles (*Haliaeetus leucocephalus*), a more social species, developed pair bonds typical of the species later in life when raised with puppets as eaglets (Simons et. al., 1988). Hawaiian crows (*Corvus tropicus*) were taught to socialize with a puppet crow and to forage for a variety of diet items (Halliday and Slater, 1994). For Operation Migration, a non-profit organization dedicated to saving a species in peril, a full-body costume is used for Whooping crane (*Grus americana*) rearing, socialization, and teaching chicks to forage, and an ultralight aircraft leads them on their natural migration ([www.operationmigration.org](http://www.operationmigration.org)).

## The Imprinting Process

It has been over a century since amateur biologist Douglas Spalding described parental recognition in chickens and over 70 years since Konrad Lorenz (1935) first used the term imprinting to describe the means by which species recognition is learned. Since that time, a large body of research has emerged in support of Lorenz's theories on filial and sexual imprinting (Sluckin, 1972; Hess, 1973). Much of this research has influenced methods of rearing animals in captivity, especially birds.

Imprinting occurs when an innate pattern of behavior becomes associated with a specific object through learning during a "sensitive period" (Lorenz, 1935). See Figure 1. Imprinting behaviors are typically differentiated into filial (parental, sibling) and sexual (mate) imprinting.

Filial imprinting occurs when a chick restricts its filial attachment and following response to a parent, sibling, or other stimulus. This occurs relatively early in development, even in the first 12 hours for some precocial species (Bateson, 1988a). Behavior such as this has been described in a taxonomically diverse collection of avian species. Though there is a “sensitive period” in which birds will prefer companionship with whatever object they have imprinted on in the first 40 days of life, more current research has shown that this factor is not stable unless “validated” by an experience later in life, i.e. mate choice. If exposure to conspecifics is extended, i.e. to 50 days, the sensitive period is invalid perhaps due to extended exposure to siblings and the adverse reaction to inbreeding (Hogan et al., 1997). Often associated with this recognition of conspecifics is the development of a fear response to novel objects such as non-conspecifics (Bateson, 1988b).

Additional early social experiences have been demonstrated to influence subsequent sexual behavior and mate choice (Immelmann, 1972). This is referred to as sexual imprinting. It is known to occur later in development than filial imprinting, with a sensitive period until fledging in some altricial species (Bateson, 1988b). While siblings may provide a model for filial imprinting, the model for sexual imprinting appears more often to be the source of food, usually the parent.

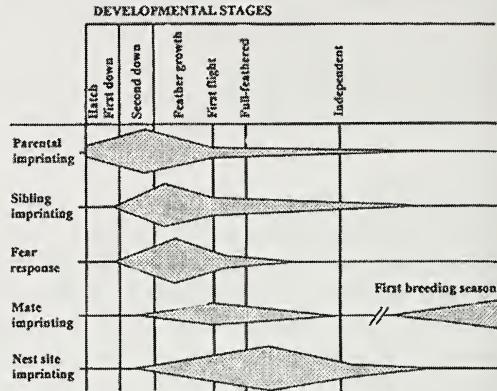
Proper filial and sexual imprinting are critical to the captive propagation of many avian species, both to maintain sustainable captive populations and to provide suitable individuals for reintroduction or other conservation programs. In the best of both worlds, all captive animals would be parent-reared and inappropriate imprinting would not be an issue, but this is not always possible. While cross-fostering to other species may be an effective method of avoiding labor-intensive hand-rearing, imprinting problems may result (Immelman, 1969).

Artificial rearing methods can be divided into the major categories below:

- 1) Hand-rearing: raising a chick without taking any precaution to hide the human form.
- 2) Ghost-rearing: raising a chick while hiding the human form and voice. This involves keeping way glass or Mylar®, ghosts (a sheet over the keeper's head and body), mirrors and minimizing light.
- 3) Puppet-rearing: raising a chick while hiding the human form and voice while using a puppet form of the adult plumage coloration intending to create species recognition in the chick during a critical stage of imprinting.

In reality, these methods are not mutually exclusive and the artificial rearing of most chicks represents some point on a continuum that combines aspects of all these methods.

Birds that imprint, either filially or sexually, on an inappropriate object are often referred to as “malimprinted.” Including puppets in the rearing process is the most aggressive measure that can be taken to avoid malimprinting. While puppet-rearing can be more labor-intensive and time consuming than more traditional rearing methods, this technique has been used with great success in a number of avian species. While a chick can imprint on objects that are dissimilar to their parents, they will imprint more strongly and rapidly on objects which closely approximate their parents. Species-specific preferences exist for certain colors and forms. Therefore puppets need not be perfect



**Figure. 1** Demonstrates the level of imprinting sensitivity based on different stages of development in birds (Reproduced from Fox, 1995).

representations or made to absolute scale, but must present basic cues, and suitable puppets are easily constructed for many species.

### Puppets and Kingfishers at Lincoln Park Zoo

The Guam Micronesian Kingfisher (*Todiramphus cinnamominus cinnamominus*) is extinct in the wild. Lincoln Park Zoo has made collaborative conservation efforts with zoos across the country, and is an active player in the Micronesian Kingfisher Species Survival Plan®. Lincoln Park Zoo produces several kingfisher chicks on average annually, and has supplemented this small population (currently just over 100 individuals) with 41 chicks total since 1991 (Taxon Report, 8 Dec. 2009).

According to the Micronesian Kingfisher SSP® Husbandry Manual, kingfisher chicks are recommended to be hand-reared birds due to the risk of inadequate parental care from captive adult birds and the inconsistency seen even with experienced pairs (Bahner and Diebold, 1998). Since Micronesian kingfishers normally clutch two eggs, chick survival rates in the nest could also decline due to siblicide or resource allocation. Parental rearing of a single chick offers beneficial experience for adult birds and the single parent-reared chick maximizes its benefits. The recommendation to artificially incubate and hand-rear the second fertile egg in a clutch allows for increased representation of individuals in a population and maximum population growth (Bahner pers. comm., 2009).

For several reasons Micronesian kingfishers were the chosen species for which to build a puppet and puppet-rear program at Lincoln Park Zoo. We currently house two successful breeding pairs and as mentioned, this species has SSP® recommendations to hand-rear. As a species, Micronesian kingfishers are relatively hardy, easy to rear chicks. While the malimprinting of chicks has not been a noted problem in the SSP®, puppets are regularly used by some other SSP®-participating institutions. This species may not easily imprint on keepers, but the use of puppets may benefit the chicks in some ways yet to be determined: if exposed to the visual cues of their adult conspecific from the beginning, the benefits of their familiarity could be seen in introductions and future breeding successes both in captive situations and potential releases to the wild.

This being said, puppet-rearing a species that is not a high risk for imprinting offers a beneficial experience for staff learning the puppet-rearing technique for the first time. Working with a species that is unlikely to imprint on humans is a good opportunity to develop and perfect the skill of puppet-rearing for future, more challenging species.

### Constructing a Puppet

#### Materials:

A bird to serve as a model	Non-toxic acrylic paints
Bondo® Auto Repair Compound *	Small putty knife
Dust masks/goggles/other personal protection equipment	Accessories such as eyes
Styrofoam® forms	Small carving knife
Headless bolt and two nuts	Rotary tool
Toothpicks	Carving and sanding bits
Gorilla Glue®	Velcro® strips

\* Bondo® is used as the construction material as it is durable and easily disinfected.

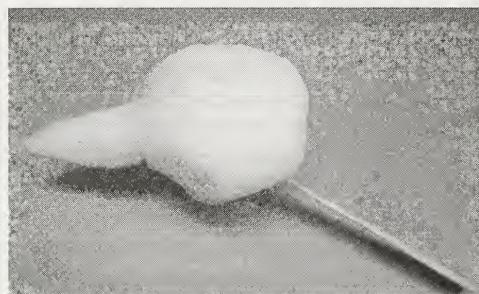
#### Procedure:

##### Step 1 – Creating a mold

Using Styrofoam® forms that approximate the size and shape of the finished puppet, begin to cut out the shape of the bird's head. Balls can be used to form heads, cones for beaks, etc. (Figure 2). If more than one piece of Styrofoam® is required to complete the head, bridge them together with toothpicks. The finished mold should be slightly smaller than the desired finished puppet (Figure 3). To form an articulate mandible, a second, independent form will be necessary.

## **Step 2 – Coating the mold**

Mix a small portion of the Bondo® with the activator as directed by the manufacturer. With a putty knife, begin to coat the Styrofoam® mold with the Bondo®. Remember to leave a large

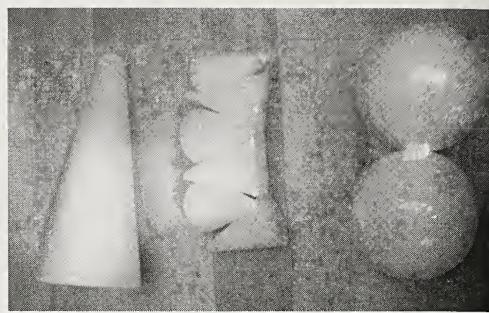


**Figure 3.** Styrofoam should be shaped to approximate desired size of puppet. (Photo by Giana Giuffre)

and drying time of the Bondo® to help create features, which may be added in several layers. At this point you need only create abstract features, not fine details. For long thin beaks, leave the underside uncovered and the Styrofoam® exposed.



**Figure 4.** Coat the mold with multiple layers of Bondo®. (Photo by Giana Giuffre)



**Figure 2.** Styrofoam in many shapes and sizes can be used. (Photo by Giana Giuffre)

enough opening in the bottom-rear of the bottom of the puppet large enough to allow its operation. Continue to add Bondo®, approximating the bird's features, until it is more than  $\frac{1}{4}$  inch thick (the thicker it is the more durable your puppet will be) (*Figure 4*). Adjusting the amount of activator you add will allow you to influence the moldability

## **Step 3 – Removing the mold**

Once the Bondo® is in the desired shape and completely dry the mold can be removed to hollow out the puppet. It can be scraped out with a spoon or knife. Back-fill the beak to create a solid piece of Bondo®. Smooth out the inside of the puppet with the sanding bit on the rotary tool. The smoother it is the more comfortable it will be to use.

## **Step 4 – Shaping the puppet**

Using the carving and sanding bits of the rotary tool, smooth, shape and detail the puppet's exterior. Use a dust mask and work outside. At this point the puppet can become as detailed and accurate as your artistic abilities allow (*Figure 5*).

## **Step 5 – Painting the puppet**

Make sure all of the dust is removed and use a non-toxic acrylic paint. A water-based topcoat can be used to protect the paint and accessories such as eyes and other features can be added at this time (*Figure 6*).

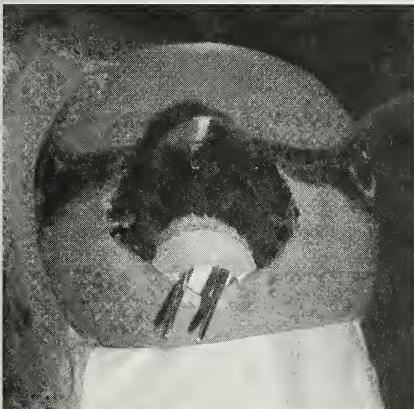
**Figure 5.** The Bondo® is smoothed and the final shape is created using a rotary tool. (Photo by Giana Giuffre)

### **Step 6 – Articulating the mandible of larger puppets**

Determine the point at which the mandible will pivot and mark this spot on both sides of the head and mandible. Use the rotary tool with a drill to drill a straight hole through all of these points. Pass the headless bolt through these points to articulate, placing a nut on either side of the mandible to hold it centered on the bolt. Back-fill the holes on either side of the head with Bondo® to hold the bolt in place and touch up with paint. For smaller puppets without an articulated mandible, cut a hole through which feeding forceps can be inserted (*Figure 7*).

### **Step 7 – Create a sleeve**

Create a sleeve to cover the forearm of the puppeteer. This can be as simple as the cutoff sleeve of a sweatshirt resembling the plumage color of the adult bird (*Figures 8 and 9*).



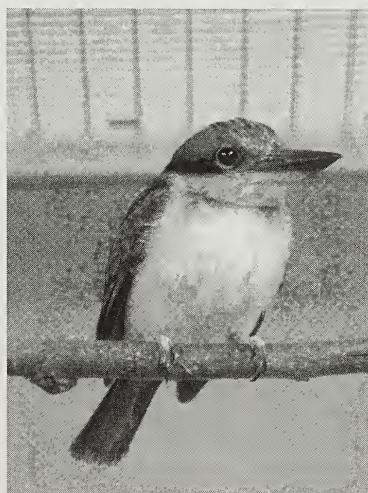
**Figure 7.** The puppet mandible can be articulated or forceps inserted through a hole. *(Photo by Giana Giuffre)*



**Figure 6.** The puppet is painted.  
*(Photo by Giana Giuffre)*



**Figure 8.** The final puppet.  
*(Photo by Giana Giuffre)*



**Figure 9.** The puppet approximates the conspecific. *(Photo by Colleen Lynch)*

## Ten tips for successful puppet-rearing

- 1) Never let the chick see you. Whether you are feeding, weighing, or cleaning it is important that the chick not see humans.
- 2) Wear a ghost. A camouflage cover over the head, arms, and body breaks up the human form and focuses attention on the puppet.
- 3) Use a feeding blind. Simple visual barriers containing one-way glass or Mylar® can be easy to work with and eliminate the feeder from sight. Remember, many one-way barriers are only truly one-way when it is light on the chick's side and dark on the feeder's side.
- 4) Practice using your puppet, if possible, before the chick's eyes open. This will make you a pro before you need to be.
- 5) Begin using the puppet during filial imprinting, before a fear of novel items sets in.
- 6) Puppet-feed even if chicks are being raised in a clutch or with mirrors to provide for filial and sexual imprinting.
- 7) Allow the chick to spend "quality time" with the puppet before and after feedings.
- 8) Do not talk in the chick-rearing area and minimize other human noises as much as possible, especially at feeding time.
- 9) Play audio tapes of the vocalizations of the adult birds of the appropriate species. This will stimulate the chick to feed and encourage auditory imprinting.
- 10) Be consistent. Be patient. Puppets can be difficult to work with until one becomes accustomed to them, but the end result is often well worth the effort

## Products Mentioned in the Text

3M Bondo® Body Filler Original Formula

3700 Atlanta Industrial Pkwy. NW, Atlanta, GA 30331

[www.Bondo.com](http://www.Bondo.com)

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# Raising Red-vented Bulbuls (*Pycnonotus cafer*) In Tropic World Asia Bird Holding

By Laurie Morgan, Senior Keeper  
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Brookfield Zoo, Brookfield, IL

On 3 December 2008 we acquired three pairs and a single female of Red-vented Bulbuls (*Pycnonotus cafer*) from Disney's Animal Kingdom and are currently participating in a population management study with this species. Prior to this acquisition the staff at the Brookfield Zoo had very limited experience with the captive management of bulbuls. Once released from quarantine on 6 January 2009 these birds were moved to Tropic World-Asia bird holding. Our goal for this species is to encourage reproduction to help sustain their captive population, and ultimately create a non-breeding flock to release to the larger exhibit. This flock will serve as a genetic reserve.

## Tropic World- Asia Bird Holding

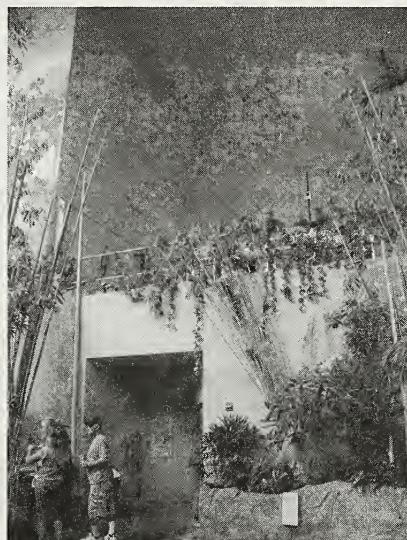
Tropic World is a large exhibit as long as a street block and is divided into three areas (South America, Asia, and Africa). The Asia exhibit of Tropic World is 75 ft. high x 110 ft. wide x 120 ft. long [22.86m x 33.52m x 36.57m]. Tropic World-Asia bird holding is located above the general public viewing area at one end of the exhibit. Sound echoes throughout the exhibit and on a crowded day the noise can be extraordinarily loud. The exhibit is temperature controlled, with the temperatures being maintained throughout the year in the 75°F [~23.9°C] range.

Skylights over the exhibit provide natural lighting throughout the year. There are 1000-watt metal Halide lamps over the public area that are set to be on from 0500 to 0930hrs and again from 1430 to 1800hrs. These lights assist with exhibit plant growth and provide supplemental lighting on overcast days. While these lights and the skylights are not directly above the bird holding area, they do provide general lighting.

The holding area is divided into six aviaries with a common meshed in service area (a hallway that has access all the aviaries). This design provides a safety area in case a bird was to escape from an aviary. The aviaries are 8 ft. high x 4 ft. wide x 7 ft. long [2.43m x 1.22m x 2.13m]. Each aviary has solid sight barriers on the sides between the aviaries. The ceiling and the ends of the aviaries are mesh (facing the exhibit and service area). All of the aviaries are equipped with a variety of natural branch perching. Three of the aviaries housed pairs of bulbuls during the 2009 breeding season.

Although the aviaries are small, having visual access to the huge exhibit may give the birds a bigger sense of their environment. Since the aviaries are at one end of the exhibit, calls from the birds bounce off the opposite wall of the exhibit creating echoes.

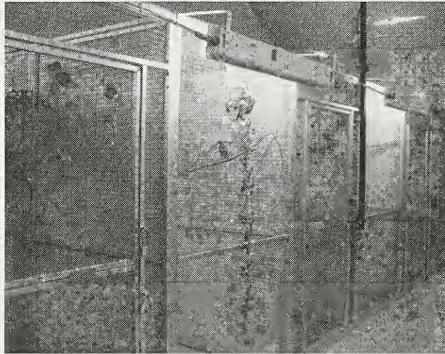
Not having previous experience with bulbuls, the set-up for each aviary was slightly different. For example, there is full fluorescent lighting on two aviaries; on one aviary they receive only a corner of supplemental lighting (all fluorescent lighting is set to go on from 0700 to 1730hrs.). Aviary 1



Tropic World-Asia view of the bird holding from the guest walk.

(Photo by Jim Schulz)

is set up with a live potted ficus tree and a small cup nest attached within the branching. Aviaries 4 and 5 have plastic palm trees in them with cup nests. A large cup nest was later added to Aviary 5. A covered cup nest was added to Aviary 4 later in the season.



Aviaries in Tropic World-Asia bird holding

(Photo by Laurie Morgan)

### General Husbandry

The care of the birds was basic. Water dishes are changed daily. The aviaries are hosed twice a week from the outside causing a minimum amount of disturbance. On occasion the aviaries require scrubbing; in these cases the amount of time spent in the aviary is limited to prevent disturbing the birds.

Their diet pan is offered each morning. A pair of bulbul receives a pan diet of varied leafy mix, frugivore (chopped up fruit and vegetables mixed with soaked Mazuri® softbill pellets. In the a.m. mealworms are added to pan. Waxworms or maggots are added to the pan in the afternoon. Once chicks hatch, additional insects are offered three to four times a day and include cricket abdomens.

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### Breeding and Rearing

In general, nesting cups were placed at eye level to limit disturbance when nests were checked for eggs. Cup nests and nesting materials were added on 19 February 2009. Cotton, pulled burlap, camel hair and untangled twine (about 4" inches long/10.16cm) were used as nesting materials. It appeared that all materials offered were used to some degree in the nests. All nesting attempts were made using the provided nests. By 4 March 2009 the first nests were complete and an egg was discovered. The last chick for the season hatched 30 June 2009.

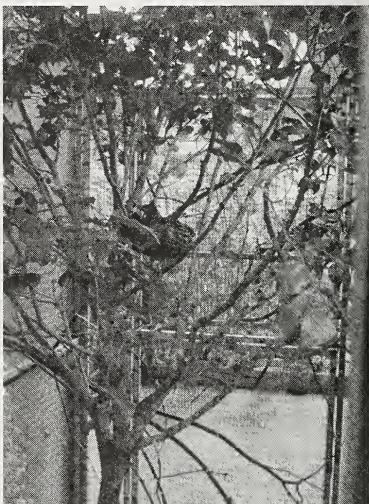
Each of the three aviaries had more than one clutch hatch and all chicks fledged, Aviary 1 fledging three clutches. All chicks were parent reared. One to three chicks hatched per clutch. A total of twelve chicks were successfully hatched and fledged in a four-month period.

### Challenges Overcome

In Aviary 4 a covered cup nest was added after eggs disappeared out of the open cup nest. This was done in hopes that the covered nest would provide better security. This worked well as the covered nest has been the nest successfully used for multiple clutches by this pair.

Initially we had problems with mice. Along with improvement in our rodent control program we pulled food in the evening and added free-standing platforms on which we placed the food pans. These actions decreased the rodent population and limited their access to the food.

Although we did not encounter any major medical issues during the breeding season we did encounter a couple of problems with the offspring. One chick was euthanized due to severe deformities to its feet. This appeared to be a genetic problem as the particular pair had previously fledged offspring with similar complications. Two chicks died and tested positive for *atoxoplasmosis*. After this finding all of our bulbul were treated for this parasite. We now place many of our passerines on an extended treatment for *atoxo*



Example of nest placement with a chick in a cup nest just prior to fledging. (Photo by Laurie Morgan)

using Toltrazuril® during the breeding season. We use a 25 mg/ml (2.5%) stock solution and add 3ml of stock solution to 1 litre of water (creating a 300 mg/gal solution). This dilution is used as the only source of drinking water. Birds are to be treated for five days on, three days off. Repeat for a total of 56 days. This treatment starts from the first day we confirm incubation and usually lasts for several weeks after fledge.

## Findings

The following items may have contributed to the overall breeding success:

- As a common factor all three aviaries have solid sight barriers between them. These panels provide visual baffles so the pairs can hear each other but cannot see their neighbors.
- The open view of the exhibit (through the mesh at the end of the aviaries) may give the birds a feeling of huge space without actually having access to it. Coupled with the echoing effect of their calls, this may convince the birds that their territories are vast, not the smaller spaces in which they are actually living. The echo effect may also convince them their neighbors are across the expanse, not next door to them.
- Since each aviary was set up slightly different and all three pairs produced multiple clutches, this species doesn't appear to be overly picky about cage set-up.
- In our experience there was no harassment by parents or their siblings once chicks fledged. In Aviary 5 we had a successful second clutch reared with previous fledged siblings still in the same aviary (there was no aggression from older siblings or parents). A total of six birds are currently housed in that aviary. In our current situation we have been able to keep parents with young long after fledging, although historically it has not been successful due to the territorial and aggressive nature of this species.
- Although we hatched no additional chicks after 30 June there is no way to know if this was due to an end of the typical breeding season or if the presence of the juvenile birds triggered the parents to stop.

## Summary

Initially when the birds were first set up we were not expecting to achieve the great success that we did so quickly. This species is noted for aggression and they are considered very territorial. Often parents



A family group of bulbuls including two clutches of juveniles. (Photo by Laurie Morgan)

will abandon their chicks or attack them once they fledge. When breeding occurred and the parents raised their young without issues, we began to look at what factors were contributing to this success. The birds have minimal disturbance from the keepers. Once chicks have hatched, abundant insect supplies are offered to discourage competition. The territories appear to be unchallenged by using the visual barriers even though the pairs can hear each other. The visual and auditory access to the larger exhibit may expand their perception of their territories. It is notable that we were able to

raise these birds in small aviaries. What is more significant is that we are still able to keep multiple clutches together over time.

As of 4 January 2009, nine of the 12 birds that fledged survived; some are still being housed with their parents.

# Sessions for All Seasons: Lappet-faced Vulture Training

By Eran Brusilow, Tricia Emrich, Tara Lee and Kevin McKay  
Animal Keepers at Disney's Animal Kingdom, Lake Buena Vista, FL

## Introduction

Every training program carries its own unique set of challenges. The Lappet-faced Vulture (*Torgos tracheliotus*) training program at Disney's Animal Kingdom is no exception. The success we enjoy as a training team is directly related to our ability to juggle a multitude of distractions – an open-air enclosure that is subject to changing weather conditions, the constant intrusion of pesky native species, the presence of inquisitive collection animals that share the vultures' habitat, the booming parades, and intraspecific interactions associated with courtship and breeding. Vulture training sessions certainly keep all of the trainers on their toes and challenge their creativity.

## Our Vultures

Disney's Animal Kingdom is home to two (1.1) rehabilitated adult Lappet-faced vultures that were deemed unfit for release back into the wild. The male and female were added to our collection in 2004 at the ages of six years and four years, respectively. Their enclosure spans approximately 6,500sq. ft. [603.86sq m] and includes rock wall boundaries, a shallow waterway, felled timber piles, lush arbors and expansive open areas. The vultures share this enclosure with Red Kangaroos (*Macropus rufus*), West African Black Crowned Cranes (*Balearica pavonia*), Lesser Flamingos (*Phoenicopterus minor*) and White-faced Whistling Ducks (*Dendrocygna viduata*). Feedings/training sessions usually occur once daily in the afternoon and roughly 300 grams [10.58 oz.] of food are distributed to each bird. Currently, there is no off-exhibit holding area in which to train, so these sessions are performed within the vultures' mixed-species habitat and always in full view of our guests.

## Training Challenges

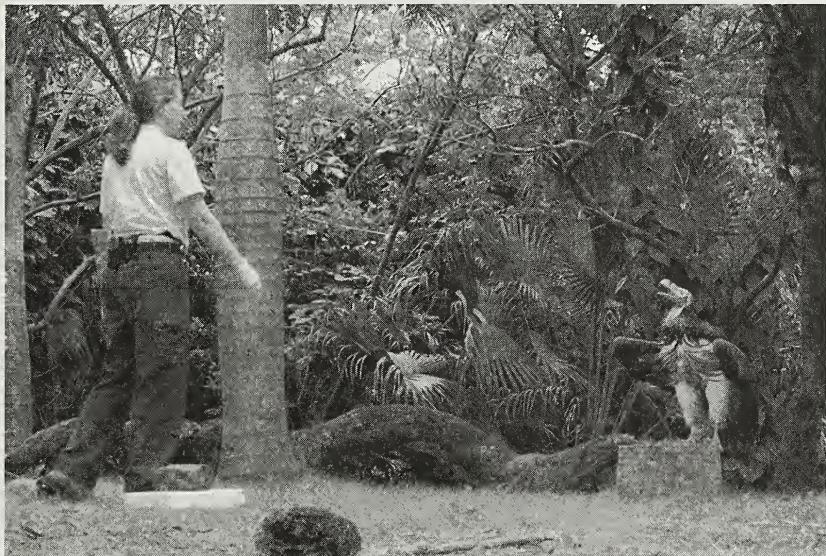
The vulture training program exemplifies Disney's well-established commitment to behavioral husbandry. Developing a successful program for our birds has been extremely rewarding, but it has also required us to creatively troubleshoot many situations. Integrating new keepers and balancing training goals with breeding goals have been two of the most significant challenges.

Maintaining consistency within our program is critical. This was first achieved in early 2009 by enlisting four zookeepers, with overlapping schedules, who would be responsible for developing and implementing specific training strategies. The availability of vulture training team members throughout the week facilitates improved communication between trainers, behavioral husbandry specialists, zoological managers and other zookeepers. Also, brainstorming and problem-solving exercises are generally more productive when a larger number of people participate. While it seems that four zookeepers overseeing the training of two birds is undoubtedly a recipe for success, multiple zookeepers training a single vulture can also create an atmosphere of inconsistency. Variation may exist in a vulture's response to the different members of the training team. Attempts to combat this phenomenon are made by constantly rotating trainers. As a consequence, it is possible that one vulture may interact with four different trainers across four consecutive days. Hence, it is imperative that the cues established for particular behaviors be performed similarly by all trainers.

We are also committed to breeding our vultures. The future propagation of this species can be greatly enhanced by incorporating a training program. However, our training progress has been adversely affected by factors that dramatically alter the behavior of our vultures. Elevated hormone levels and various environmental stimuli associated with the onset of breeding season (winter and spring) cause aggressive responses. The vultures may respond aggressively toward approaching trainers in attempts to defend their nesting territory. Mate aggression is also frequently observed as the birds vie for space or food. The size and speed of these vultures can make negative responses like these, extremely intimidating for nearby trainers.

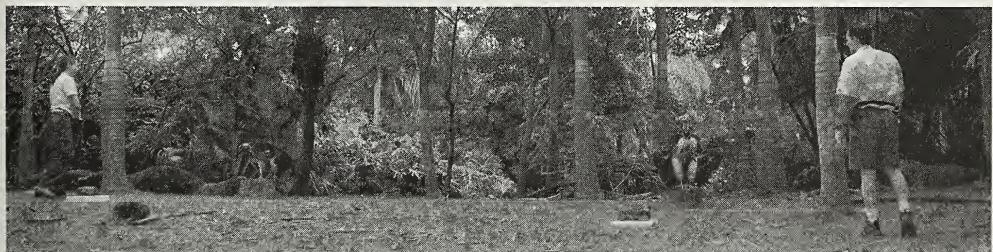
## Meeting the Challenges

Within their first year at Disney's Animal Kingdom, the vultures were trained to station on large logs that measure 15 inches in diameter, 20 inches in height and are situated 15 feet from one another [38cm in diameter, 50.8cm high, and 4.57m apart]. Upon receiving a visual "station" cue and verbal "go on", they were reinforced for mounting the stations and displaying a relaxed posture. Feeding was often done by a single trainer, from a moderate distance and over a relatively short time period. Several attempts were made to advance these rudimentary behaviors over the next four years, however progress proved difficult.



**Figure 1.** Tara reinforces "Bones" on his station. (*Photo by Eran Brusilow*)

During the spring of 2009, in the wake of the breeding season mayhem, changes were made to usher in a new era of vulture training. The first change involved restructuring the core training team to include four individuals who were enthusiastic about working with the vultures. Feeding could now be performed by two trainers on a daily basis. Secondly, we reduced the feeding distance to a few feet (at the bird's discretion) and the number of reinforcements was increased in order to lengthen training sessions. Although the vultures appeared to take well to having their own trainers, they were still able to see one another throughout the sessions. This meant that the birds would often disengage from their own sessions to investigate the other trainer, the other vulture, a dropped meatball, etc. To combat these sudden breaks in concentration, we began to reinforce the vultures for rotating on their stations as we walked around them. Eventually, the birds rotated so that they faced opposite directions. We wanted to create two independent training sessions that happen to occur at the same time and in the same immediate area (Fig. 2).



**Figure 2.** Kevin and Tara working vultures independently. (*Photo by Patricia Emrich*)

Encouraged by the vultures' rapid progress, we compiled a short list of other behaviors that we

deemed essential for improving their care. Training the vultures to stand on a scale platform seemed to be a natural progression. We constructed two durable scale covers topped with thick perches, which fit snuggly over a wireless scale. These scale covers were introduced into the enclosure over the course of a couple weeks during training sessions and were eventually placed a few feet from the stations without the vultures reacting negatively. When we first began shaping the “scale” behavior, the trainers gave a visual “scale” cue, said “scale” and immediately enticed the vultures off of the stations in the direction of the scale covers. Following the “scale” cues, golf ball-sized meatballs would be rapidly tossed at  $\frac{1}{4}$ ,  $\frac{1}{2}$ , and  $\frac{3}{4}$  of the distance from the station to the scale cover. As the vultures ate the food items closest to the scale covers, they would be asked to station again. Once the birds began responding to the “scale” cues before the first meatball was thrown, we decreased the number of reinforcements along the path to the scale cover and increased the amount of time between each reinforcement. Eventually, we performed the “scale” cues and only reinforced a vulture for placing a foot on the scale cover. Our female was the first of the two birds to receive the “scale” cue, dismount her station, walk calmly toward the apparatus and step atop the scale cover. Less than one week later, the wireless scale was placed under the scale cover and her first ever voluntary weight was recorded.

Although the “scale” behavior was a tremendous accomplishment for our training team, the vultures were developing a bad habit. They began to jump from either the station or scale to catch food items that were tossed to them. Such undesirable behavior could cause injury to the birds and the trainers, so we agreed that hand-feeding was a likely resolution. We began conducting training sessions while wearing thick leather gloves on our left arms. The habituation period was surprisingly brief and both birds did not seem the least bit unsettled at the sight of the awkward gloves. When the birds were stationed, trainers would place a meatball between their left index and middle fingers, hold a second meatball in their right hand, extend the gloved hand toward the bird and reinforce them for remaining calm by tossing the meatball from the right hand. After a few days, the gloved hand could be extended so closely to the beak that we simply allowed the vulture to gently pluck the meatball from between our gloved fingers (Fig. 3).



**Figure 3.** Kevin hand-feeds a calm “Carri.”

(Photo by Eran Brusilow)

We also introduced the vultures to a “heel” behavior, in which they are asked to calmly follow their trainers throughout the enclosure. They were originally baited off of their stations after a visual “heel” cue was demonstrated by the trainers. We would cue, drop a meatball at our feet, back up a short distance, drop another meatball at our feet, back up a short distance, etc. One important point to mention is that we tried to keep the vultures moving and always finished the “heel” behavior back on the station. Gobbling down a small meatball takes mere seconds, so the trainers had to be ready with reinforcements and back-up plans to keep the birds in tow. Similar to our “scale” behavior progressions, the birds eventually began to dismount their stations immediately after they received the visual “heel” cue. Baiting was then phased out and the birds were not reinforced until they arrived close enough to trainers to be hand-fed.

There are instances in which our vultures will extend one or both wings during a training session; to balance in breezy conditions or as a response to a dive-bombing red-shouldered hawk, for example. We seized these opportunities to capture a “wing present” behavior by extending our hands to mirror those of the birds, bridging and immediately reinforcing their behavior (Fig. 4).

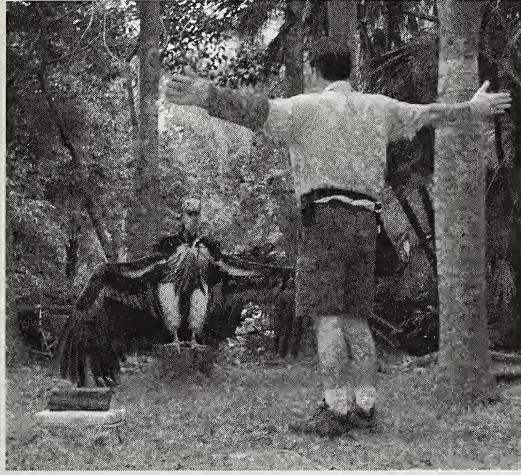
## Looking Ahead

When breeding season arrives, we do not introduce new behaviors until the birds exhibit normal behavior. We do, however, continue with their daily training regimen. The vultures frequently cooperate during training sessions, albeit less reliably. The hope is to simply maintain learned behaviors throughout the breeding season, after which we will usher in new training strategies.

For example, we hope to build upon the “heel” behavior so that the vultures shift voluntarily into a small containment annex. This is essential because landscaping tasks occasionally need to be conducted inside the habitat. In these instances, the vultures are corralled into the containment area by a large number of zookeepers, until the work is finished; a very negative experience for all involved. We also plan to expand the “wing present” behavior in order to regularly perform feather trims. Trainers will then be able to diminish flight capability, without restraining the birds.

**Figure 4.** Kevin performing the “wing present” cue.

(Photo by Patricia Emrich)

up to six months of each year, cutting our effective training window in half. Despite these major challenges, we have had much success in maintaining positive training sessions by putting together an enthusiastic team, creating a solid training plan and communicating with each other. Our first four years of vulture training were marked by plenty of trial and error, learning what works for the vultures as well as the trainers. Persistence was key, not giving up when our methods did not produce the desired results. All of our training goals are by no means complete but our commitment to the program has allowed us to accomplish a great deal in this last year. As the program continues to evolve we are positioned to seamlessly transition from one season to the next, building upon past successes.

## Avian Trivia . . .

**Why don't perching birds fall out of trees when they sleep?** When perching birds sit, a tendon on the backside of the ankle automatically flexes locking their toes around the branch. With feet locked, sleeping birds don't fall. As the bird stands up, its feet release.

- There are 109 species of birds that have become extinct. • 90% of all species that have become extinct have been birds. • The maximum speed of a chicken is nine miles per hour. It takes 40 minutes to hard-boil an ostrich egg. • Feathers make up 10% of a bird's total body weight. • If an average man had a metabolism comparable to that of a hummingbird he would have to eat 285 pounds of hamburger every day to maintain his weight. • The hummingbird is the only bird that can fly backwards. • The pouch of a pelican has a capacity to carry 12 quarts. • New York City has the largest population of peregrine falcons in the world. • The average life span of a robin is 12 years. • The nest of a bald eagle can be 12 feet deep, 10 feet wide and weigh over a ton. • Birds actually dream when they sleep. According to research conducted by the University of Chicago, they dream about their songs, have dream rehearsals, and sing the same songs better the next day. • All of the swans in England are the property of the queen. Disturbing or bothering them is considered a serious offense. • An ostrich's eye is twice as large as its brain and weighs 3.3 pounds. • Frigate birds can fly at a speed of 260 miles per hour. • The American crow is found in every USA state except Hawaii.

Source: <http://www.cockatielcottage.net/trivia.html>

# Successfully Managing a Mixed-Species, Free-Flight Aviary

By Paula Kolvig, Assistant Curator; Heather Leeson, Biologist III;  
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Moody Gardens, Galveston, TX

## Rainforest Exhibit

Moody Gardens is a non-profit organization which boasts lush landscaped grounds, IMAX® theaters, restaurants, a hotel, convention center, and two main live animal exhibits: the Rainforest Pyramid and the Aquarium Pyramid. The Rainforest Pyramid exhibit at Moody Gardens opened in 1993. The original scope of the exhibit had been planned as a botanical garden with a few live animals for enhancement. However, within the first year, the focus changed to allow equal emphasis on animal and plant diversity found in the rainforest ecosystem. This exhibit, which covers one square acre, is a ten-story glass pyramid that depicts the diversity of three rainforest regions around the world.

The collection plan evolved and developed through the years and culminated in 2008 as an exhibit with a wide variety of taxa and species housed together in this realistic rainforest setting. A diverse representation of tropical birds, fishes, amphibians, reptiles, and small mammals made up the animal component of the Rainforest exhibit. Each new exhibit enhancement over the previous years brought on a focus of the different taxa of animals listed above. Every third year or so, the focus would change and new animals were brought into the mix. The animal inventory in September of 2008 was roughly over 1,000 animals of six different taxa.



The Rainforest Pyramid at Moody Gardens.

(Photo by Heather Leeson)

This paper will cover the avian species and management of the exhibit up until September 2008. Hurricane Ike hit Galveston, where Moody Gardens is located, on 13 September 2008. Due to the extent of damage from the storm surge, surviving animals from the Rainforest collection were relocated to many AZA facilities. The evacuation began on 17 September 2008 and, to some degree, relocation is still underway. Over 800 animals were moved to zoos and aquariums within a three-month period. While some of the animals have since been brought back to Moody Gardens, the majority remains out on emergency loan until the Rainforest repair and renovation work can be completed.

Since the exhibit was intended to be an immersive experience for the visitor, animals were free-roaming or free-flighted as much as possible. Although this paper will focus on the avian species, a brief mention of other animals that were free-roaming gives a clearer picture of the exhibit's complexity. Free-ranging mammals included Cotton-top Tamarins (*Saguinus oedipus*) and Two-toed Sloths (*Choloepus didactylus*). Of these, the tamarins were trained to recall and managed strictly for behaviors. The sloths were fed from particular stations and some training was successful, but they were not recall trained.

Reptiles that could be found free-roaming through the exhibit were Sailfin Lizards (*Hydrosaurus amboinensis*); Tokay Geckos (*Gekko gecko*); Asian Water Dragons (*Physignathus cocincinus*), Basilisks (*Basiliscus plumifrons* and *B. vittatus*), Day Geckos (*Phelsuma species*) and historically Green Iguanas (*Iguana iguana*). Of these lizard species, all but the Tokay geckos were recall and target-trained to better manage their care. The larger lizard species were consistently counted, fed, and managed; whereas some of the smaller species, like the young basilisks, were identified and trained as often as they presented themselves.

A few amphibian species were also exhibited as free roaming in the Rainforest Pyramid. Species displayed included Green Tree Frogs (*Hyla cinerea*), Squirrel Tree Frogs (*Hyla squirella*), as well as historical attempts at displaying Poison Dart Frogs (*Dendrobates* species), and Bullfrogs (*Rana catesbeiana*). The Poison dart frogs were an unsuccessful species in the collection due to predation by birds. The Bullfrogs were eventually phased out of the collection due to predation by fish and birds when they were small; in addition, as they grew larger, there was concern of bullfrog predation on small birds and fish. Behavior management was not attempted on any amphibian species.

The Rainforest Pyramid also included an outdoor waterfowl exhibit. This open-top exhibit was viewed by windows and did not have public access. The 50,000-gallon shallow pond with waterfalls featured various waterfowl, pelicans, flamingos, as well as one mammal species, Red-flanked Duiker (*Cephalophus rufilatus*). All of the birds in this exhibit were flight restricted either by pinioning or wing clipping. The pelicans (and historically a Magnificent Frigate) were rehabilitated, non-releasable with various wing injuries that restricted flight. The land to water ratio was approximately 60% water to 40% land, and the space was utilized for holding of some tortoises as well. Some behavior management was underway on a few species of both taxa.

### **Avian Collection**

The majority of the avian species were free-flighted; a few were free-roaming due to flight restriction by pinioning. By September 2008, the Rainforest was home to a variety of tropical pigeons, doves, turacos, waterfowl, small psittacines, ibis, oropendolas, rollers, and finches to name a few. Table 1 lists the current avian collection. The larger psittacines are housed in off-exhibit holding and perch-trained. They are perched throughout the rainforest for several hours during the day and their wings are clipped on a regular basis.

As the avian collection developed and changed over time, new species were added or phased out depending on the how well they adapted to the exhibit. As much as the size and complexity of the exhibit provided opportunities for breeding and behavior management, the exhibit also created challenges for captive avian management. The main challenge to successful management was having a variety of birds with different niches under stimulus control. The exhibit size, while a bonus to many birds, proved difficult for staff to get the free flighted birds where we needed them when we needed them. Nests were also easy to miss if they were high enough in the canopy of the exhibit and access to these nests was restricted as well.

### **Avian Diets**

As mentioned above, managing a diverse free-flight aviary is a challenge. With a diverse collection of birds comes a diverse set of nutritional needs and requirements. Our primary goal is to meet those needs while maintaining healthy weights on a variety of animals. With the provision of a diverse array of food items, feeding methods, and monitoring, the proper nutrition for each bird group can be achieved.

The Rainforest staff utilized a large amount of food items for the aviary that range from specialty items like formulated dry food items to fresh produce and some higher protein sources. The majority of the formulated diets, which are commonly used in the zoological setting, include items from Mazuri® diets (Parrot, Flamingo, Softbill, etc). In addition, a variety of seeds and grains were offered. Supplements, such as vitamins and bird gel, were added to the diets to ensure that picky eaters were receiving adequate nutrition even if they picked around the formulated foods. A variety of fresh fruits and vegetables were offered differing in sizes, amounts, and types. Items such as apples were a staple for any fruit eater, and depending on the type of bird, could be presented in chopped, halved, or finely diced form. This was the case for all produce offered. Rotating the types of fruit and vegetables allowed for better enrichment and nutritional opportunities.

Utilizing different feeding methods allowed the staff to accommodate for all of the bird types while creating a positive guest experience. Two different types of feeding methods were primarily employed within the Rainforest: feed stations and free feeding. Height, location, quantity, and feeding preferences were some of the considerations taken into account with the presentation of food. Feed stations were either stationary (permanent) or mobile and situated along the trail, out of reach of guests. The four permanent stations allowed for the placement of a food pan within a



Pink pigeon chick and parent at feed station #2. (Photo by Jeana McDowell)

concrete tree stump feeder. The first feeder at the entry of the Rainforest was approximately at eye level, placed further within the foliage, and inaccessible to guests, yet allowed them to see the birds feeding. The next two feeders were stationed about shoulder height, within the view of the guests, and below small rock ledges. The final feeder was at ground level and semi-secluded by foliage off the pathway. A fifth pan was regularly placed in a howdy cage to acclimate birds to being fed inside, thereby allowing staff to easily capture untrained birds out of the Rainforest as necessary.

The free-roaming waterfowl had originally been fed at various ponds throughout the exhibit, according to their range. For example,

the Hottentot ducks were fed from a pan in a stream located on the African trail of the exhibit. Throughout the years, the waterfowl that were not contained within their particular ranges began to show up at one particular pond each morning for feeding. It was not determined whether this was due to competition, a preference of food presentation and location, or type of food pan. Due to this fact, the feeding for the various waterfowl in the Rainforest changed to a broadcast feed in the "ibis" pond on the South American trail. This was one example as to how the animals acclimated over time and feeding techniques were adapted to their needs. The flock of Scarlet ibis was fed from a stationary feed pan in their pond, and the waterfowl periodically shared feeding times and food with the ibis. Mobile feed stations consisted of feeder logs, such as bamboo feeders with branches for piercing fruit and vegetables, or log feeders that contained holes for the placement of food items. Staff-made bamboo feeders can easily be constructed out of a log and nails that are used to pierce the food. These feeders can be easily removed, washed, and sanitized.

Free feeding occurred along the trail as the food cart was taken into the exhibit. This also allowed for the best observation time for staff. Birds often followed the food cart and over time, the birds that were more acclimated and brave would ride on the food cart helping themselves to the buffet before them. This bird behavior afforded the staff great training and enrichment opportunities.

The feeding methods discussed helped staff to monitor the birds through observations and training. Many birds would visit particular stations in a known pattern and time. Some were more random with their feeding preferences, but each feeding opportunity became a management opportunity for the staff. The exhibit opened at 1000hrs and the first feeding would occur close to opening time. This consistency allowed guests to catch a glimpse of the majority of birds in the collections, as well as their feeding habits and natural behaviors. The morning feed was an opportune time for training sessions and was used as a tool to passively condition the birds to a food station. Longer business hours during the summer allowed for more feedings and training sessions. Regardless of the season or business hours, the food pans were available to the birds for a minimum of seven hours. This was done for pest control reasons and to allow the more timid birds to find food and forage throughout the day, as it was typically the bolder species that had first dibs on food.

During the breeding and nesting season animals expend more energy and some may require increased protein intake. In order to accommodate for this change in energy demand, normal diets were supplemented by incorporating items such as formulated breeder grains, live invertebrates, and live rodent pinkies. Some species were target-fed these items; for example, the Blue-bellied rollers were quite capable of catching items mid-flight and the Sunbittern was acclimated to taking crickets off feeder tongs. Other supplements were added into all of the pans since the birds had free choice of where to eat. The amounts were monitored and adjusted as needed. Through the years, many birds were acclimated to hand feeding. While this technique ensured a certain bird received a certain item, it was only used sporadically and with caution, as the staff did not want a constant association with human fingers and food. In a free-flight situation where the public has contact with so many animals, this can be startling to the unsuspecting guest pointing at something.

Food presentation and distribution encouraged equal feeding and enrichment opportunities. Occasionally the food wasn't mixed up but was presented in distinct sections of the pan, or was chopped differently for enrichment. Other ways to meet the various needs were to alternate soaking pelleted foods with water and/or diluted fruit juice, cooking some of the vegetables periodically, and rotating in some seasonal produce items. Enrichment was also offered in the form of live invertebrates (crickets, worms, roaches etc), spray millet, or alternating different seeds.

The exhibit itself provided ample enrichment for the animals (of all taxa), but especially for many of the birds. Many fruit bearing trees produced plenty of food for the birds to snack on. For example, at least three types of ficus produced figs and many of the palm fruits were available year round. Other types of fruit that grew in the exhibit were two types of citrus, banana, and star fruit (which was a staff favorite as well). In addition to the naturally occurring horticulture enrichment, a variety of bugs were naturally available. These additional food items afforded many natural avian behaviors which was a great guest experience but a challenging husbandry issue. Birds that are feeding themselves at the top of the canopy have very little incentive to come to a keeper no matter how many times a favorite food item is presented. This created yet another challenge to the overall management of the animals and exhibit at Moody Gardens.

### **Avian Breeding**

Since the Rainforest opened in 1993, we have housed 84 species of breeding birds; of those, 41 species have successfully bred! That's a 48% success rate of which we are very proud. These included birds that live in pairs or groups of three or more. Some of our paired birds included: Yellow-breasted ground doves, Coscoroba swans, Crested oropendola, Fairy bluebird, Peacock pheasant, Pink pigeon, Piping guan, and Shelducks. Some examples of group birds are Finches, Nicobar pigeons, Speckled pigeons, Collared doves, Scarlet ibis, Pintails, and Crested wood partridge.

The location of a nest can tell keepers a lot, most importantly where the nest is, which is challenging to find in a lush and heavily planted immense exhibit. By knowing the location, keepers can tally approximate hatch dates, keep watch for chicks around that date, monitor behavior of parents, and coordinate with the horticulture staff so watering of plants in that area can be done cautiously.

There are infinite places to build a nest and a variety of birds that build nests in different niches. Due to the sheer vastness of the Rainforest it is impossible to account for every nest. No material is provided, aside from what occurs naturally in the exhibit. Historically, nest material such as excelsior was provided, but was not utilized by the bids. Also, supplemental commercial finch nests were hung around the exhibit, but again, the birds that were successful built their own from naturally occurring materials. The nests in the Rainforest consisted mainly of sticks, leaves, air roots, and curtain ivy. Many nests weren't noticed by staff, and successful breeding was only noted when a chick was found hanging around one or both parents. Surprise! For many birds such as finches, fairy bluebirds, pigeons, and doves this was a common occurrence. For other birds, nest locations were more consistent and predictable.

The Scarlet ibis usually nested in the fall in the highest trees around the largest water feature, making for very precarious chick exploration. The Yellow-breasted ground doves and Palawan peacock pheasant chose new locations for each ground nest, which were always viewable from the pathway. The Crested oropendola's nest is quite obvious and our group built theirs suspended from high canopy points in the center of the exhibit. Piping guans built their nests approximately every three months in the African region of the exhibit next to ledges facing the behind-the-scenes area. These nests were furthest from public view and difficult to access. The Pink pigeons preferred the densely-covered ficus trees for each nest. The outdoor flamingo pond exhibit had many nesting opportunities as well. Frequently, waterfowl nest boxes were placed along various points of the landward side of the exhibit. The Coscoroba swans successfully produced cygnets each season, and their nest was in the same general location each time.

Nesting behavior is quite intriguing. Some males are extremely territorial, such as the swans and the piping guan, which would almost require keeper protective equipment when servicing the area. The ibis flock would cease coming down to eat while only one or two nests were being tended to. The pair of Yellow-breasted ground doves would take turns sitting the nest, while the male Peacock

pheasant would not only refuse nesting duties but would continue to court his mate while she was sitting the nest. Once a nest site had been chosen, there was nothing keepers could do to change its location. A very determined pair of Speckled pigeons would continuously roost on slanted rockwork above the exit pathway. Each month, an undeveloped egg would be found broken on the pathway... evolution at its best.

Some birds were excellent breeders in the exhibit; others never quite figured it out or appeared to not acknowledge the presence of a con-specific mate in the exhibit. Six species were constant contributors to the genetic pool for their captive populations: Palawan peacock pheasant, Coscoroba swan, Piping guan, Speckled pigeon, Collared dove, and many waterfowl species. Often times, we were faced with overpopulation for our exhibit. Finding homes for many of these species can be difficult and interest seemed to be cyclical. The Piping guan pair that produced many chicks throughout the years presented a problem in that as offspring were sent out to other zoos, a population was created that had many individuals related to our pair. Because of this, further breeding of the pair became problematic and needed to be controlled. In this particular case, as nests were built by the guans, eggs were pulled and replaced with dummy eggs. This helped staff to manage the breeding, but had a negative impact in that the male became quite offended by the presence of staff near his territory, his nest or his mate, and eventually near his recall station. A behavior problem was created as the result of this management technique but was later addressed through training. Inbreeding was another problem with a few of the pigeon species. The exhibit challenges for staff were not so challenging to prolific birds. Other concerns were over-breeding of a female (a medical concern), and chick abandonment by a female being constantly courted. All of these situations were monitored and managed as much as possible. Training became a primary way to step in and manage several of the situations mentioned above.

Why does a certain species flourish in this exhibit when others don't? This question plagued the staff each year at breeding season. The best conclusion was individual character and nest location. A bird's 'personality', whether in a pair or group situation, was important because staff has noted that birds that are too shy or too imprinted do not breed well in this exhibit. It was a vast and extremely natural exhibit, and birds that don't comprehend natural behaviors (too shy or too imprinted) are not skilled at courting or nest making, which makes successful breeding nearly impossible. For example, a slightly imprinted male Sunbittern showed indifference to any female introduced into the exhibit. Species that are closely related can be problematic, such as one male Bleeding heart dove that showed a slight preference to a female Yellow-breasted ground dove. Those situations were monitored carefully. First time pairs were monitored as much as possible, but when Crested oropendolas nest as high up as they did, observations were difficult. In this particular case, the female died in the nest. The male provided staff with the first clue when he stopped visiting the nest, prompting a tree climbing and nest removal venture.

All chicks that hatch are vital to the conservation of its species, whether they belong to an SSP®, PMP®, or other type of managed program. The proudest accomplishment by far is with the highly endangered Mauritius Pink Pigeon (*Columba mayeri*). For years, the Rainforest housed non-breeding males for the SSP®. In 2006, the management plan allowed an attempted breeding, with the ultimate goal to see if multiple pairs could eventually be exhibited together. 2.1 were housed together for four months before the first successful hatching and offspring. This female chick was later moved to another facility. In November 2007, we were given the opportunity to attempt two pairs of Pink pigeons, something that had not been successful at other facilities. After a short acclimation period, the new female and bachelor male paired up and a few months later had a chick - a male; four months later they produce another chick, a female. What did staff do to encourage this success - nothing beyond a lot of observation. The exhibit itself provided the right atmosphere and space needed to be successful, and staff knew where and when to expect chicks once nesting behavior was observed. This provided us with the upper hand when it came to pulling for banding, health checks, etc. These birds proved to be much shyer than most of the other pigeons on exhibit, and showed very little interest or desire to participate in training sessions.

### **Avian Behavior Management**

October 2002 was the start of a training experiment with 1.0 Black-necked aracari (*Pteroglossus aracari*). The finches and butterflies that cohabitated the rainforest exhibit with this aracari were

being chased, harassed, and on occasion, eaten. The goal was to train him to go into a crate for capture. It was difficult to recapture fast birds out of such a large exhibit, especially one as intelligent as this aracari. Staff had exhausted all resources to capture or trap him when training by operant conditioning was suggested. The expectations were not high, but training began anyway. To the surprise of the staff, he was captured in December and many of the other birds had begun participating in the training sessions; and so the free-flight training program began and was formalized over the years. What started as an experiment and last ditch effort became the primary management tool for staff working in the Rainforest.

As this program began to flourish, the main goal was to train a few behaviors to any bird that wanted to participate. Participants included breeders, non-breeders, chicks, adults, and singletypes. The time to train the birds only took 15 minutes and was done as little as once a week or as often as five times a week; it depended on the trainer's schedule for the day. By starting at the entrance to the Rainforest exhibit and slowly walking through, the trainer would stop where birds were seen and attempted to train them. If there was interest from the birds, training occurred and if there was not, the trainer moved along. As the trainer's schedule changed to care for different species, so did the responsibility of training the birds. While the primary trainer attempted sessions during the month, the bird keeper was encouraged to train during feeding times so as not to add to the maintenance of that routine. Feeding combined with training could take up to 30 minutes instead of 10-15 minutes for just feeding. Overall, not a huge portion of time to an already busy day.



Fairy bluebird entering crate.

(Photo by Heather Leeson)

Several basic behaviors were trained such as bridge, recall, and crate. Other behaviors were added as needed, such as scale, station, and stay. Reinforcement was always food from their daily diet and preferences were shown for peas, corn, grapes, and mealworms. This variety appealed to the majority of the birds, some showed a preference for one food items, while others would work for two or three. The bridge was a clicker. The recall sound varied based on animal and locations-whistle, shaker can, or three rapid clicks of the clicker. This was done to avoid congestion of animals at a single location. If a bird is trained to come to a

specific location upon hearing the whistle, it would not show up at a different location upon hearing the shaker can. This gave shy birds the chance to train without feeling like prey in a larger group session. The crate used was a Vari-kennel® with a wire top instead of a plastic top. This was chosen because it let more light inside, thereby illuminating the entire interior and allowing birds to see inside from the front and top of the crate. While inside the crate, birds were able to see the outside surroundings from all directions. Feeling comfortable with such a scary object was vital to the success of training a bird to willingly enter and have the door closed. The scale utilized for voluntary weights was a small kitchen gram scale. Some birds were crated then weighed, others figured out how to step on the slippery surface to get weighed. After several years of training, staff was able to get monthly weights on a variety of free-flighted birds. It's a great, non-invasive and stress-free technique to enhance husbandry of our bird collection.

Despite the basic behaviors some birds displayed behaviors that needed extra attention, so specific trained behaviors were added to their repertoire. For example, the male Piping guan's behavior became increasingly problematic for the staff members. It appeared to be displaced aggression that became self-rewarding for the bird. This was not only an issue for staff, but a potential issue for the public. The goal was to teach him that his aggressive tendencies would no longer be tolerated. By not receiving a reaction from keepers, he was no longer being rewarded for his aggression and he was in a mindset to be trained to station and stay. There were 19 pathway benches located throughout the exhibit, and he was rewarded for going onto any bench (his station), for displaying calm body language while on station (no vocalization or crest raising), and for staying on station while staff

moved around and eventually left the area. Due to years of receiving high reinforcement for pestering staff, each new keeper (regardless of their section) was required to learn this new station and stay behavior with the bird. Once the guan and the new keeper roles were correctly established, there were minimal issues. However, during nesting season the negative behavior was likely to reoccur but was manageable.

This training program also became helpful and necessary during emergency situations, such as medical concerns or injuries. Birds that were crate trained were easily available for medical exam or treatment. This alleviated stress for not only the bird, but staff as well. Crate training and easy recapture due to the successful training was the only way in which the staff was able to move animals for Hurricane Rita in 2005 and Hurricane Ike in 2008.

Offspring of trained parents were in a unique position to learn not only from their parents, but to learn operant conditioning starting at only a few days post-hatching. Any chick seen was given the opportunity to learn, and most willingly engaged once they were old enough to eat on their own. While with parents they learned by watching and became acclimated to the bridge. Chicks were taught bridge, recall, and crate. One of the hand-raised chicks, a Speckled pigeon, also learned step up and scale. The trust that developed between trainer and chick as they grew was important because as they started to become more independent, capture for shipment became a priority. A majority of the chicks produced were trained to enter a crate voluntarily. For this to be truly successful with



Piping guan on station while trainer waits for crest to lower so he can receive reinforcement. (Photo by Heather Leeson)



0.1 Palawan with chick being bridge trained. (Photo by Heather Leeson)

on a few days a week. The benefits far outweigh any increased load to the standard husbandry routine.

Over the past seven years, staff did not note any detrimental impact of training on the breeding success in the exhibit. Ten species of breeding birds (appx. 30 individuals) have participated in the training program since 2002. Seven species of offspring (appx. 15 individuals) have been trained. Overall, what staff observed was less stress on parents and chicks at the time of capture for whatever reason, trust between bird (parent or chick) and trainer never diminished, and parents continued to train willingly year after year, chick after chick. It became an integral part of their life and of our bird husbandry routine. A new goal for staff, once the collection is back from evacuation, is for every bird to learn a bridge. This will pave the way for all birds to learn more if they choose and increase our husbandry success.

### Avian Success and Challenges in Our Collection

Due to the large architectural footprint of the exhibit, the keeper staff had to overcome several

challenges to ensure not only the quality of life of the animals, but also the best possible guest experience. These challenges were met and often overcome through ingenuity, although sometimes accepting things as they are is also meeting the challenge.

One challenge staff faced was the necessity of providing feeding stations and nesting locations that were both accessible for the birds and easy for keepers to observe and maintain. By strategically placing feeding stations, staff was able to bring some of the more colorful birds down to lower levels that would have normally stayed higher in the canopy. Again, the abundance of edible food naturally occurring in the exhibit made this even more challenging.

Another hurdle to overcome was the training program previously discussed. While not necessarily a daunting task, the logistics were. The nature of the exhibit, number of distractions by other animals, sounds of the morning maintenance, and the public required staff to keep sessions brief and behaviors simple. In addition to the distractions, many of the birds had short attention spans, necessitating short, specific training sessions. Guest interruption could hinder sessions, but provided an opportunity to showcase the program.

Accurate counts and daily observations were always difficult, especially for larger groups of birds. One solution was to keep a running tally to track who had seen what bird, when, and where. Using other departments (horticulture and education staff members) also helped accomplish this goal. If a bird was not observed as frequently as usual, staff would start aggressively searching. Often times, the absence of certain birds meant nesting, but sometimes it meant there were medical concerns.

The decision to parent-rear or hand-rear was often determined by factors beyond staff control, but the exhibit layout and landscaping made things more difficult if a chick needed to be pulled for any reason. As mentioned earlier, nesting sites were not always in the best location for humans and sometimes not in the best location for the birds either. Although several birds did have difficulty establishing breeding success, others thrived. Mostly a hands-off policy worked and staff intervention was kept to a minimum.

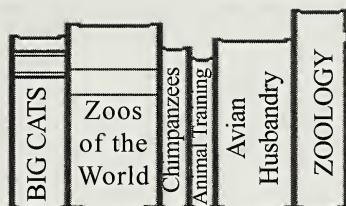
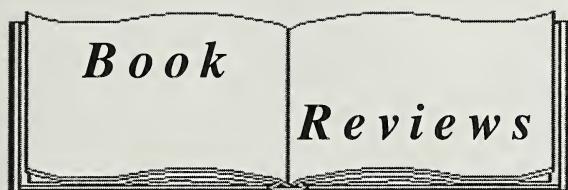
Other challenges faced in the Rainforest exhibit were not unlike most other facilities. Often times when there seemed to be enough space for birds to thrive, it may not always have been in the right kind of space. Or, where certain bird species might have gotten along in one situation, once introduced to a new exhibit, new territorial behaviors developed. As we strived to maintain a large variety of species and taxa under one roof, a balance had to be achieved. Often times this balance would shift for an unknown reason resulting in death or removal of a species that didn't work in this environment. Flexibility and observant staff helped immensely. One example of this was the male Palawan pheasant that eventually had to be isolated into a smaller exhibit within the rainforest due to some aggression issues with a group of Crested wood partridges

The nature of the Rainforest Pyramid, coupled with the number of animals, provided a fantastic opportunity for guests to view free-flighted birds in about as free a state as one can find in a zoological setting. The constant enrichment of a large number of birds, several levels of rainforest, and naturally growing food sources provided challenges to husbandry. But these challenges also led to many successes in husbandry as mentioned throughout this paper. For the last 17 years, the Rainforest had showcased plant and animal life in a unique and realistic setting. Changes in staff and collection have only strengthened our ability to cope with challenges, thereby making each success, no matter how small, a proud accomplishment.

While the Rainforest exhibit remains closed to the public, repairs and renovations are well underway. First and foremost, plans are being made for the "migration" back to Moody Gardens. The generous zoos and aquariums that offered to assist us in our time of need are close by and bringing animals back will be one less challenge to face. The renovations plans include a new canopy walkway to provide our guests with a view of the upper portion of the exhibit, as well as provide areas for keeper/guest interaction. New challenges await the staff including opportunities to expand our avian collection and husbandry skills. The updated Rainforest Pyramid at Moody Gardens will open in Spring 2011.

**Table 1 - Avian Inventory Moody Gardens**

Common Name	Taxonomic Name	Exhibit	Flighted
American White Pelican	<i>Pelecanus erythrorhynchos</i>	Flamingo Pond	No
Brown Pelican	<i>Pelecanus occidentalis</i>	Flamingo Pond	No
Scarlet Ibis	<i>Eudocimus ruber</i>	Rainforest	Yes
American Flamingo	<i>Phoenicopterus ruber</i>	Flamingo Pond	No
Ne-ne	<i>Branta sandvicensis</i>	Flamingo Pond	No
Coscoroba Swan	<i>Coscoroba coscoroba</i>	Flamingo Pond	No
Wood Duck	<i>Aix sponsa</i>	Flamingo Pond	No
Mandarin Duck	<i>Aix galericulata</i>	Rainforest	No
Lesser Brazilian Teal	<i>Amazonetta b. brasiliensis</i>	Rainforest	Yes
White-cheek Pintail	<i>Anas bahamensis</i>	Flamingo Pond	No
Cape Teal	<i>Anas capensis</i>	Rainforest	No
Baikal Teal	<i>Anas formosa</i>	Rainforest	No
Hottentot Teal	<i>Anas punctata</i>	Rainforest	No
Chiloe Wigeon	<i>Anas sibilatrix</i>	Flamingo Pond	No
Silver Teal	<i>Anas versicolor</i>	Rainforest	No
Ringed Teal	<i>Callonetta luecophrys</i>	Rainforest	No
Red Crested Pochard	<i>Netta rufina</i>	Flamingo Pond	No
South African Shelduck	<i>Tadorna cana</i>	Flamingo Pond	No
Radjah Shelduck	<i>Tadorna radjah</i>	Flamingo Pond	No
Common Shelduck	<i>Tadorna tadorna</i>	Flamingo Pond	No
Common Piping Guan	<i>Aburria p. cumanensis</i>	Rainforest	Yes
Palawan Peacock Pheasant	<i>Polyplectron emphanum</i>	Rainforest	Yes
Crested Wood Partridge	<i>Rollulus rouloul</i>	Rainforest	Yes
Sunbittern	<i>Eurypyga helias</i>	Rainforest	Yes
Nicobar Pigeon	<i>Caloenas nicobarica</i>	Rainforest	Yes
Speckled Pigeon	<i>Columba g. phaeonota</i>	Rainforest	Yes
Mauritius Pink Pigeon	<i>Columba mayeri</i>	Rainforest	Yes
Pied Imperial Pigeon	<i>Ducula bicolor</i>	Rainforest	Yes
Moluccan Imperial Pigeon	<i>Ducula perspicillata</i>	Rainforest	Yes
Bleeding-heart Dove	<i>Gallicolumba luzonica</i>	Rainforest	Yes
Ylw.Breasted Grnd Dove	<i>Gallicolumba tristigmata</i>	Rainforest	Yes
Diamond Dove	<i>Geopelia cuneata</i>	Rainforest	Yes
Brozewing Dove	<i>Phaps chalcoptera</i>	Rainforest	Yes
Collard Dove	<i>Streptopelia decaocto'</i>	Rainforest	Yes
White Cockatoo	<i>Cacatua alba</i>	Other	No
Sulfur Crested Cockatoo	<i>Cacatua galerita</i>	Other-Education	No
Scarlet chested parrot	<i>Neophema splendida</i>	Rainforest	Yes
Senegal Parrot	<i>Poicephalus senegalus</i>	Other-Education	No
Hyacinth Macaw	<i>Anodorhynchus hyacinthinus</i>	Rainforest-perch birds	No
Hybrid Macaw	<i>Ara species</i>	Rainforest-perch birds	No
Blue and Yellow Macaw	<i>Ara ararauna</i>	Rainforest-perch/Education	No
Scarlet Macaw	<i>Ara macao</i>	Rainforest-perch/Education	No
Military Macaw	<i>Ara militaris</i>	Rainforest-perch birds	No
Monk Parakeet	<i>Myiopsitta monachus</i>	Rainforest	Yes
Orange-winged Amazon	<i>Amazona amazonica</i>	Other-Education	No
Cuban Amazon	<i>Amazona leucocephala</i>	Other	Yes
Violet Plantain Eater	<i>Musophaga violacea</i>	Rainforest	Yes
Blue-bellied Roller	<i>Coracias cyanogaster</i>	Rainforest	Yes
Mexican Emerald	<i>Aulacorhynchus p. prasinus</i>	Rainforest	Yes
Toucanet			
Fairy Bluebird	<i>Irena puella</i>	Rainforest	Yes
Saffron Finch	<i>Sicalis flaveola</i>	Rainforest	Yes
Silver-beaked Tanager	<i>Ramphocelus carbo</i>	Rainforest	Yes
Blue-grey Tanager	<i>Thraupis episcopus</i>	Rainforest	Yes
Troupial	<i>Icterus icterus</i>	Rainforest	Yes
Crested Oropendola	<i>Psarocolius decumanus</i>	Rainforest	Yes
Red-throated parrot finch	<i>Erythrura psittacea</i>	Rainforest	Yes
Society Finch	<i>Lonchura domestica</i>	Rainforest	Yes
Zebra Finch	<i>Poephila guttata</i>	Rainforest	Yes
Orange Bishop	<i>Euplectes o. franciscanus</i>	Rainforest	Yes
Pin-tailed Whydah	<i>Vidua macroura</i>	Rainforest	Yes



## On the Wings of Cranes

By Lowell M. Schake, 2008

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Paper, 339 pages \$24.95

*Review by Leslie Keys, Principal Keeper,  
Bird Section, Detroit Zoological Institute  
Royal Oak, MI*

If John James Audubon is the father of the modern conservation effort, then Lawrence Walkenshaw is the father of Crane Biology. As a child, he was fascinated with the natural histories of the birds in his neighborhood and made meticulous notes about them. As he grew to adulthood, he was pressured into becoming a dentist to support his family, but always his major interest lay in the winged world. He was the prime mover in the state of Michigan to study and protect the critically endangered Kirtland's warbler. Due to his observations and flawless records he realized long before others that these tiny birds were in trouble. Always a lover of sandhill cranes, he became an expert in locating their nests in Michigan and was invited to partner with the Royal Saskatchewan Museum to help successfully locate the elusive whooping crane nesting area in Canada. He also studied sparrows, flycatchers and hundreds of other species.

With a forward by Dr. George Archibald of the International Crane Foundation, this biography of Lawrence Walkenshaw, chronicles the life of perhaps the greatest amateur scientist and field biologist in recent times. Author Lowell Schake takes us from the early days of Walkenshaw as a child through to his death in 1993. Besides being a history of Walkenshaw's work in the field of bird research, Schake shares the personal life of this unassuming and tireless man. He brings to life what it takes to be truly great in the field and helps us realize what the efforts of a single dedicated individual can do for an entire field of study.

This is a great book for anyone interested in field research, birding, or Mr. Walkenshaw himself.

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## Avian Websites to Check Out.....

AvianWeb.com - <http://www.avianweb.com/birdspecies.htm>

The Ornithology Website - <http://birdwebsite.com/research/index.htm>

Birding.com - Top 25 Birding Sites - <http://www.birding.com/bestwebsites.asp>

Bird Website Links - <http://www.richard-seaman.com/Birds/links.html>

The Cornell Lab of Ornithology - <http://www.allaboutbirds.org/guide/search>

Birds of the World - <http://birdix.com/main.htm>



**African Penguin (*Spheniscus demersus*)**  
(Photo: Bethany Wlaz, Rock Island Keeper, The Maryland Zoo in Baltimore)

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